Chapter 5

Sprayable, Strippable Films And Controlled Humidity Sprayable, Strippable Films

GENERAL

The use of spray-applied synthetic vinyl resins carried in solvents is one of the methods of protecting large pieces of equipment for long-term storage or sealing door and window joints in various vehicles. There are various types of sprayable, strippable films, each described by specification.

Although the application of sprayable, strippable films has been an effective way of providing protective covers, or cocoons, over very large items such as locomotives, diesel engines, aircraft, etc., remaining in outdoors storage for long periods of time, its use has declined due to newer, safer, and more environmentally acceptable methods. The application of sprayable, strippable films is declining because of the following:

- X Economics (Manpower intensive and expensive).
- X Hazardous (Chemicals used require utmost safety precautions and environmental use/disposal procedures).
- X Newer methods (such as nitrogen blankets, flexible containers for long-term storage, and the building of more controlled-humidity storage facilities).

Nevertheless, the use of the following chemicals and techniques are still approved for DOD use.

MIL-C-16555

This specification covers two types and two classes of coatings intended to protect metal surfaces from deterioration and physical damage on items in outdoor storage and during shipment. They are capable of being sprayed and stripped from painted surfaces in addition to metal surfaces. The films can quickly be peeled off in large pieces. MIL-C-16555 establishes the percentages of the virgin unprocessed vinyl resins, plasticizers, solution and film stabilizers, pigments, and solvents to be used in the formation of the compounds. The solvent used is methyl-ethyl-ketone (MEK) with 20 percent of toluene allowed. The specification has separate requirements for testing samples after weathering. The compounds provide waterproof protection.

MIL-PRF-6799

This specification covers the requirements for water emulsion protective, strippable, sprayable, or multicoat coatings for application over metallic, painted, and plastic surfaces. They are classified in one type (type II) and three classes. Type II - Multicoat system (exterior has four classes); Class 1 - Basecoat (black) is intended for use when protected item is shipped fully covered or stored under cover, as a basecoat. Class 5 - Topcoat (white or olive drab) is intended to be used only as top coating for Type II, Class 1 materials. In combination, this coating system serves to protect such items as entire aircraft, missiles, rockets, and transportation vehicles during outdoor storage and oversea deck loaded shipments. The Type II - Class 6 topcoat (white) is a single coat

strippable protective coating used on items such as entire aircraft, missiles, rockets, and transportation vehicles during outdoor storage and oversea deck loaded shipments. Type II - class 7 topcoat, brushable is used for repair or patching to either of class 5 or 6 above.

ADHERING, STRIPPABLE COMPOUNDS

Application and Other Uses of MIL-C-16555 Compounds

MIL-C-16555 compounds are applied by heavy duty spray equipment (figure 5-1). The film, 4 hours after application, must have a dry thickness of 0.35 to .045 inch. The first coat is applied horizontally, overlapping each pass 50 percent. The second coat is applied at right angle to the first coat. Each successive coat will be at right angle to the previous coat until the required thickness is built up. This takes about seven coats. The coating will be overlapped on the adjacent metal for a distance of 2 inches. Besides their intended use as protective coatings of metal and fabric surfaces, these materials are used on vehicle preservation over Osnaburg (cotton drill) stretched on a framework to form a watershed, on engine grills, gun tubes, etc.

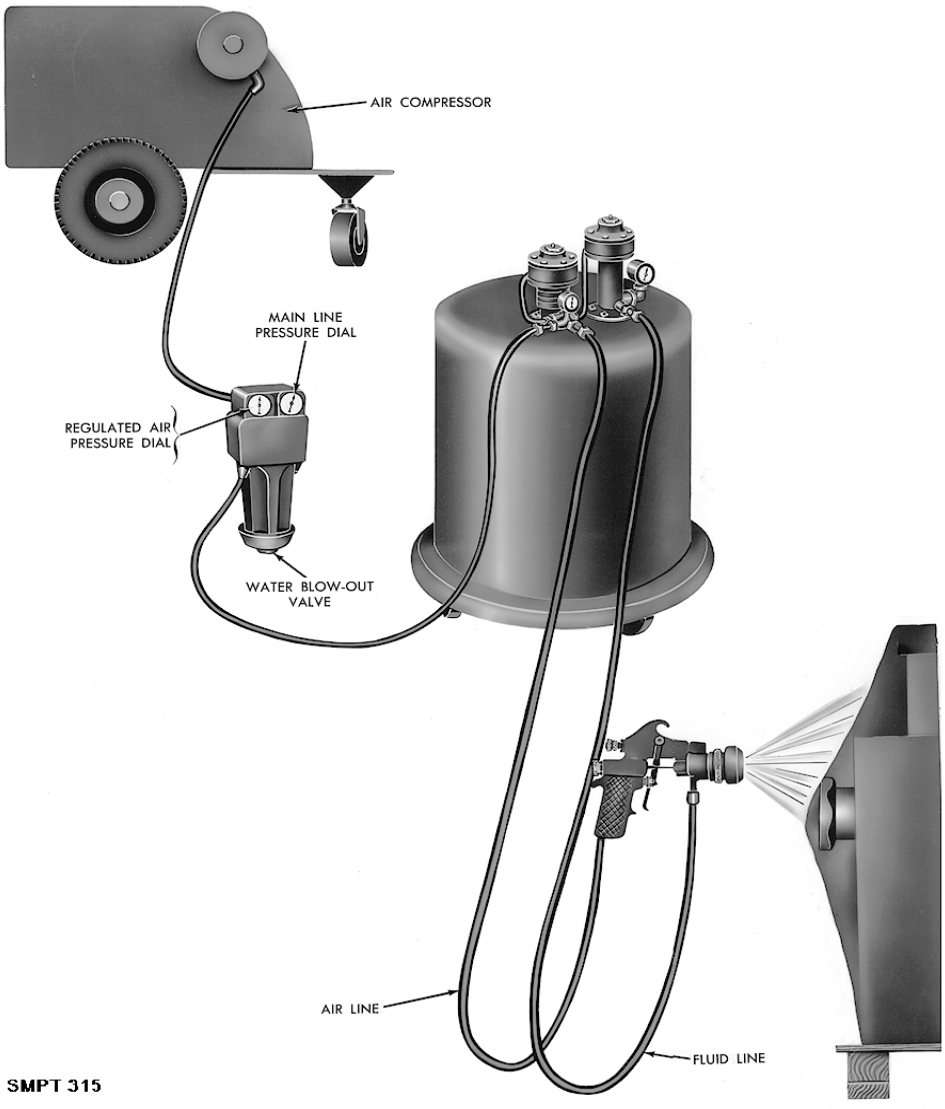

Figure 5-1. Sprayable, strippable films equipment.

Safety Precautions

Since MEK (methyl-ethyl-ketone) is the principal solvent used in the adhering, strippable compounds, a word of caution is in order as this solvent is classified as dangerous from health and fire standpoints. Methyl-ethyl-ketone is also known as "butanone" and is considered more toxic than acetone.

Health Precautions

When spraying compounds containing MEK, the operation should be performed in well-ventilated areas to keep the vapor concentration to a minimum. The operator should wear an especially designed mask as specified in safety regulations. Smoking must not be permitted within 50 feet of the work being sprayed.

Fire Precautions

The vapors of MEK form flammable mixtures with the air at temperatures as low as 24ºF. MEK has the property of spontaneous ignition in the presence of oxidizers such as potassium and dichromate, sodium dichromate, chromic acid, and potassium permanganate.

MIL-PRF-6799

This specification establishes the requirements for water emulsions, protective, strippable, sprayable, single or multicoat coatings for application over metallic, painted, and plastic surfaces. The coatings furnished under this specification are of the following type and classes:

X Type II, Class 1, Black. This material is intended for use as a strippable protective coating for acrylic plastic bulk materials and assemblies containing acrylic plastics when the protected item is shipped fully covered or stored under cover; and (2) as a basecoat for Type II, Class 5 and 6 materials.

X Type II, Class 5, White or olive drab. This material is intended to be used only as a topcoating for Type II, Class 1 materials. In combination this protective system serves as a sprayable, strippable, protective coating for application of metallic, painted and plastic surfaces, such as entire aircraft, missiles, rockets, and transportation vehicles during outdoor storage and overseas deckloaded shipments. For Army, the color shall conform to FED-STD-595, Color N 024081.

X Type II, Class 6, white. This material is intended to be used only as a topcoating for Type II, Class 1 material. In combination, this protective system serves as a sprayable, strippable, protective coating for applications on metallic, painted and plastic surfaces, such as entire aircraft, missiles, rockets, and transportation vehicles during outdoor storage and overseas deckloaded shipments. It is recommended for use with Binks Model No. 18 or VeVilbiss MBC spray gun or equal.

CONTROLLED HUMIDITY

GENERAL

Prevention of deterioration of clean metals and organic materials, especially in the complex assemblies of modern military equipment, is often most economically attained by the elimination of the excessive amounts of moisture from the storage atmosphere. The general principles set forth in this paragraph are basic to understanding dehumidification of storage air whether it is inside a Method 50 pack or an oversea warehouse storing prepositioned military supplies, or a large warehouse.

ATMOSPHERIC AIR

Atmospheric air is a remarkably constant mixture of many true gases, principally nitrogen (78 percent) and oxygen (21 percent). In addition, watervapor is always mixed with atmospheric air. The actual amount of watervapor present in atmospheric air varies widely. For instance, there can be as much as 500 times as much watervapor actually in the air on a humid summer day in Louisiana as on a winter day in Alaska. Although temperature does not determine the amount of watervapor actually present in atmospheric air, temperature is the only factor that determines the ability to hold watervapor.

RELATIVE HUMIDITY

In storage atmosphere, it is not the actual amount of watervapor present that determines the effect on corrosion. It is the actual amount which can be held at ambient temperature. This ratio is relative humidity. Figure 5-2 illustrates what happens to relative humidity in an inclosure with a fixed amount of actual watervapor as temperature changes. With every 20ºF, increase in temperature, the ability of air to hold watervapor doubles and the relative humidity is cut by half. As temperature goes down, relative humidity rises approximately 50 percent for every 20ºF until it reaches 100 percent. After this, any further drop in temperature results in condensation of liquid water.

RELATIVE HUMIDITY IN STORAGE ATMOSPHERE

The preservation quality in dehumidified storage atmosphere is controlled in terms of relative humidity. A sustained 50 percent relative humidity is the maximum considered safe for the storage of ferrous materials. Relative humidity is maintained under 50 percent in controlled humidity storage to provide a margin for the control of increases in relative humidity which result from nightly temperature drops.

BASIS FOR RECOMMENDED RELATIVE HUMIDITY LEVEL

It has been demonstrated in laboratories that relative humidities up to 100 percent alone are not destructive to pure ferrous metals. It has been concluded that the corrosive action is started when dirt, salt dusts, polluting gases, or impurities in the metal absorb moisture from the air to wet metal surfaces. Since it has been observed that this wetting action does not take place when the relative humidity is below 50 percent, maintenance of a sustained relative humidity at this level provides a "preservation" atmosphere.

DUST

All dusts are basically objectionable because of their water-absorption characteristics, but acid dusts and salt dusts are the most destructive. Clay dusts, which are the most common, are alkaline, whereas dusts from sulfate-containing soils or from decayed organic matter are acidic. Salt dusts include sodium chloride from sea water mist, ammonium sulfate from the combustion of bituminous coal, and calcium chloride from roads which have been treated for deicing or dust laying.

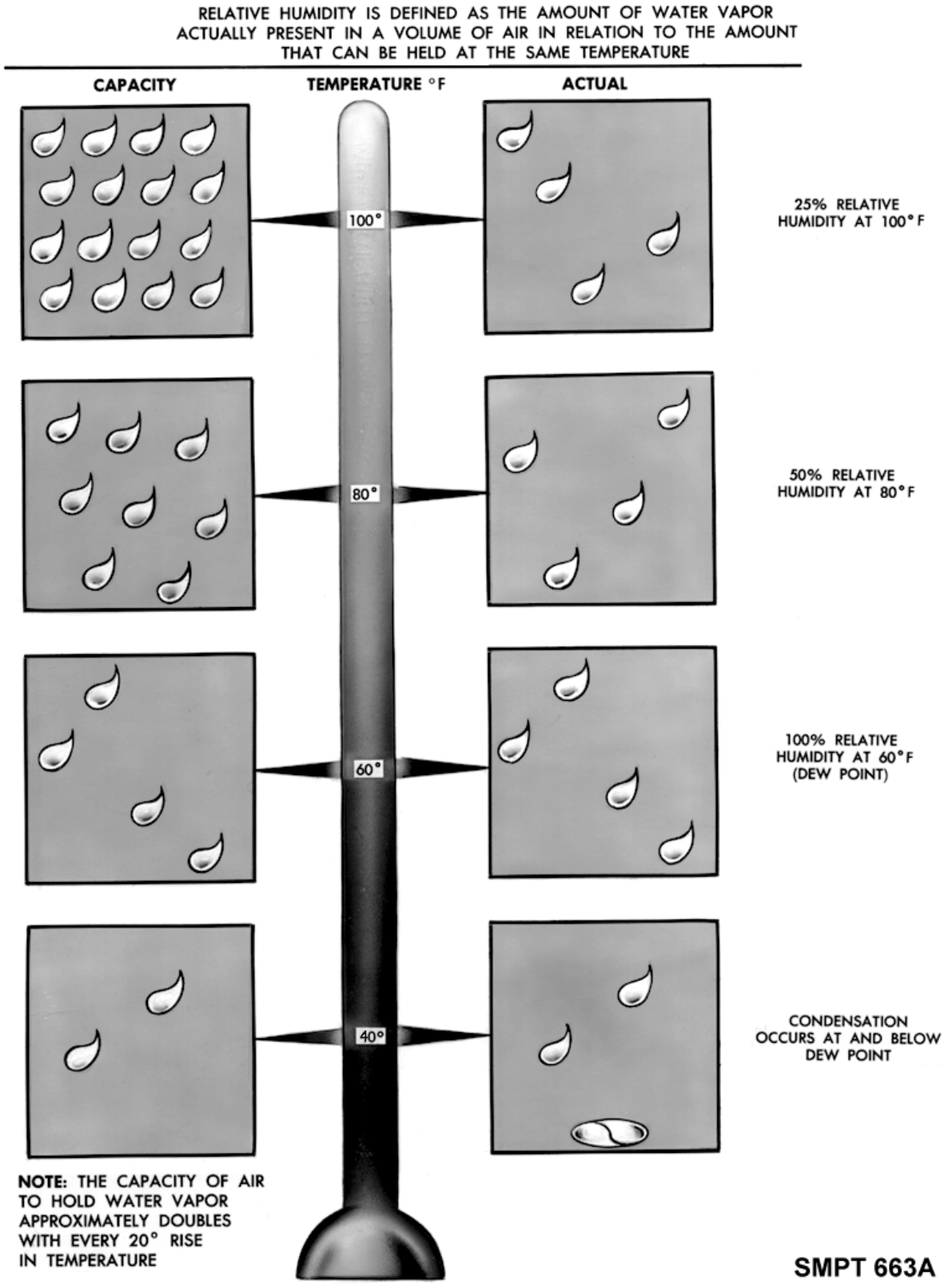

Figure 5-2. Temperature and relative humidity relationship.

HUMIDITY CONTROL

Military publications classify methods of controlling relative humidity by removing watervapor from storage air as "static dehumidification" and "dynamic dehumidification". Relative humidity can also be controlled by heating the storage area. Descriptions and criteria for selection of these methods are as follows:

Static Dehumidification

Method 50 provides a fixed static environment in a sealed watervaporproof pack in which a dehumidified atmosphere is maintained by bagged desiccant. Activated desiccant in quantities specified by MIL-STD-2073-1C can maintain an average 20 percent relative humidity even during normal temperature drops. In time, packs must be opened to replace saturated desiccant, since there is a slow but continuous transmission of watervapor through the flexible barriers used in Method 50.

Dynamic Dehumidification

This application deals primarily with dehumidification by forcible dynamic circulation for storage air through mechanical equipment which removes watervapor. The one type of mechanical dehumidifier most commonly used in military applications is discussed below. The devices for controlling dehumidifiers and recording dehumidification results are also described below. Generalizations which determine the suitability of various structures for dehumidification and the storage of military equipment in controlled humidity storage are also discussed below.

Static vs. Dynamic Dehumidification

Static dehumidification is utilized in Method 50 packs and other airtight watervaporproof metal containers. Dehumidification of such airtight containers over 5000 cubic feet, especially of nonmetal construction, is generally more economically accomplished by dynamic dehumidification.

Humidity Control by Heating Storage Area

In the paragraph above, it was stated that relative humidity decreased by half with every 20ºF rise in temperature. Heating the storage area may be the most economical manner of dehumidification where yearly average temperature is under 50ºF and where comfort heating is also desired. To illustrate the practical limitations of this method, after outside temperature reaches 75ºF and relative humidity reaches 75 percent, an inside temperature of over 90º would be required to keep relative humidity at a 50 percent level. It should be noted that in static and dynamic dehumidification, relative humidity is controlled by removing watervapor from the atmosphere; in heating, no watervapor is removed.

Dynamic Dehumidification Equipment

There are two kinds of equipment through which storage air is power-circulated to remove moisture. The next paragraph explains the flow and function of refrigeration-type equipment and explains the flow and function of the solid absorption, i.e., desiccant bed equipment. Desiccant bed equipment is best suited to the average military dynamic dehumidification operation. Refrigeration-type equipment is suitable in warmer climates where air does not have to be cooled below 40ºF to cause condensation.

Function of Refrigeration Dehumidification Equipment

Figure 5-3 illustrates the flow of air on through typical refrigeration dehumidification equipment used to remove watervapor from storage air. Storage air first passes over the cold evaporating coils (the refrigerant in the coils takes the heat it needs to vaporize out the air passing over the outside of the coils). In this process, storage air is cooled below dewpoint, causing watervapor to condense. As it drips off the evaporating coils, it is drained out of the storage area. The limitation of this method of dehumidification can be seen at this point. If the air has to be cooled below 40ºF to reach its dewpoint, frosting of the coils tends to make this process uneconomical.

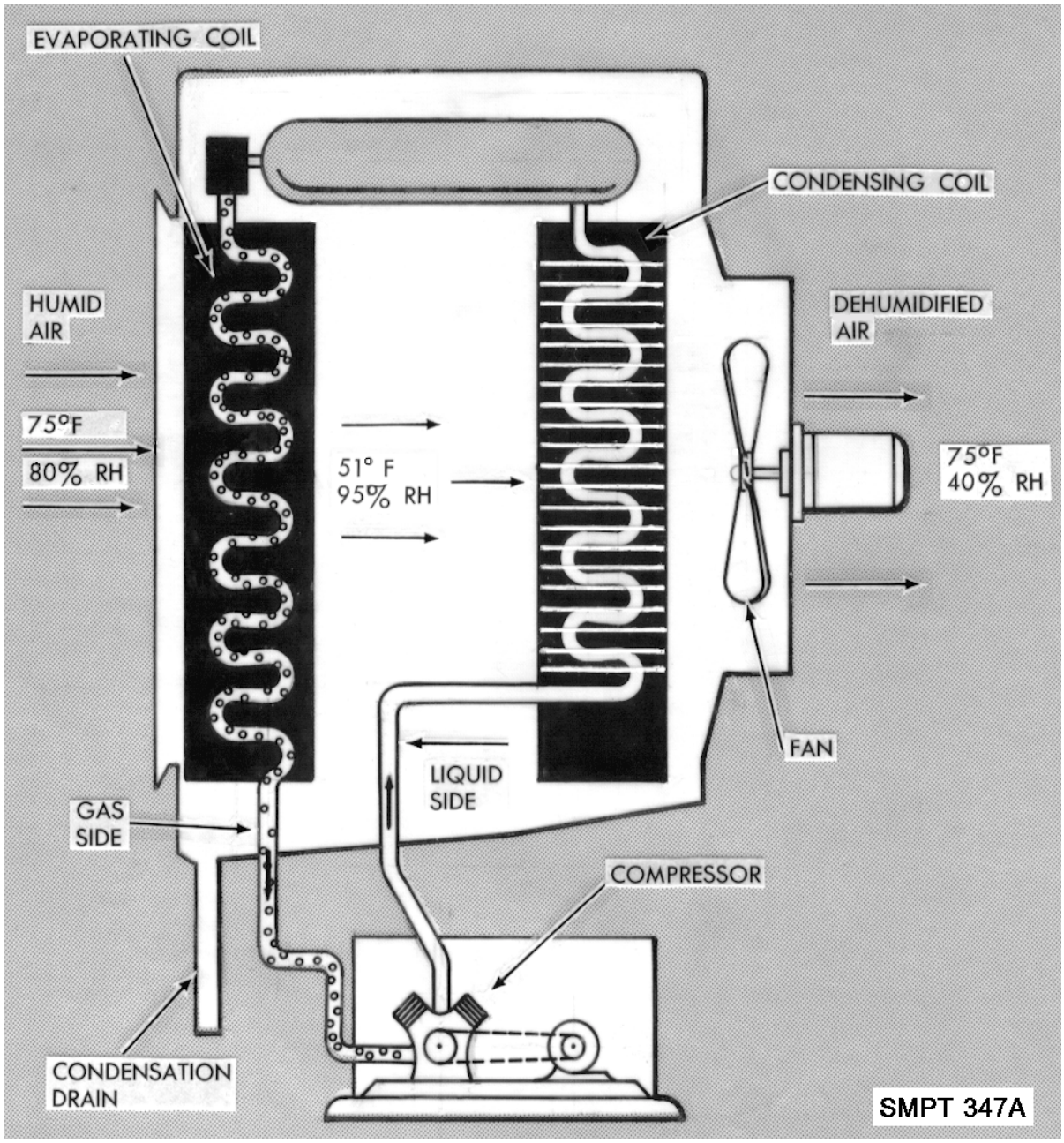

Figure 5-3. Flow diagram-mechanically refrigerated dehumidifier.

Necessity to Reheat Storage Air

An apparent contradiction appears in figure 5-3 in that the storage air, after passing over the cold evaporating coils where watervapor was condensed, now has a higher relative humidity than when it entered the dehumidifier. This is because the ability of air to hold watervapor decreases approximately on half with every 20ºF drop of temperature. At this point, the storage air in the equipment has less actual humidity but more relative humidity than when it entered. By passing this air over the condensing coils of the dehumidifier, which are warm like the coils on the back of a refrigerator, the air is warmed and relative humidity drops well below the original level. Since this form of dehumidification is best suited for warm climates, there is a tendency to place the condensing coils outside the storage area. This results in comfort cooling but may actually increase the relative humidity in the storage area.

FUNCTION OF SOLID ADSORPTION (DESICCANT) DEHUMIDIFIERS

The basis for this method of dehumidification is the surface attraction of watervapor by granular materials known as desiccants which have tremendous microscopic surface area. Materials such as silica gel or alumina can absorb 40 percent of their weight in moisture without undergoing physical or chemical change. The key to the use of these materials is that the adsorbed moisture can be vaporized by heating saturated desiccant to about 300ºF. This "reactivation" process is accomplished automatically in mechanical dehumidifiers.

Single and Dual Bed Machines

Figure 5-4 pictures a typical solid adsorption machine. It has two beds or two chambers which hold desiccant, plus a relatively simple arrangement of air ducts, blowers, filters, air valves, heaters, and controls. Smaller capacity single bed machines are available. These cannot provide a constant supply of dehumidified air since the same desiccant bed must be cycled to dehumidify and to be reactivated. These two phases are carried on simultaneously in dual bed machines.

Dehumidification Cycle

Refer to the adsorbing desiccant bed on the right-hand side of figure 5-5. Notice the position of the cycling valves. Storage air is simply brought through intake and filter, power circulated by blower through the activated desiccant bed and returned to storage area.

Reactivation Cycle

Refer to the reactivating desiccant bed on the lefthand side of figure 5-5. Notice the position of the cycling valves. Outside weather air is ducted to the machine, filtered, power circulated by blower over heaters which raise the temperature to approximately 300ºF, through the desiccant, and returned to the outside. A thermometer in the duct returning the reactivation air to the outside provides a check for cycling time setting. When the temperature rises noticeably, the heat is no longer being used to volatize moisture adsorbed on the desiccant, and the automatic timer setting should cause the cycling valves to turn, thereby reversing desiccant bed cycles.

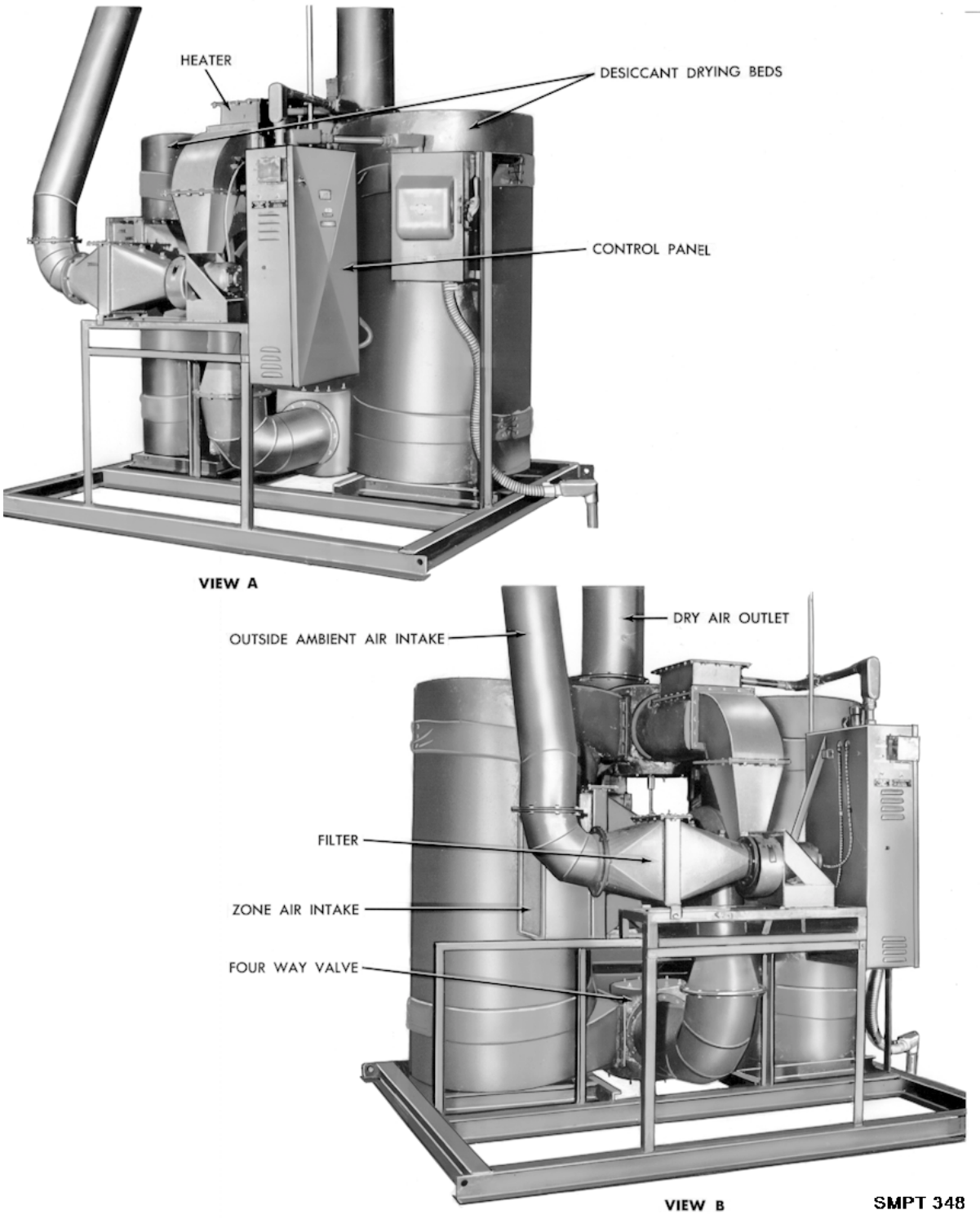

Figure 5-4. Typical dual bed desiccant dehumidifier.

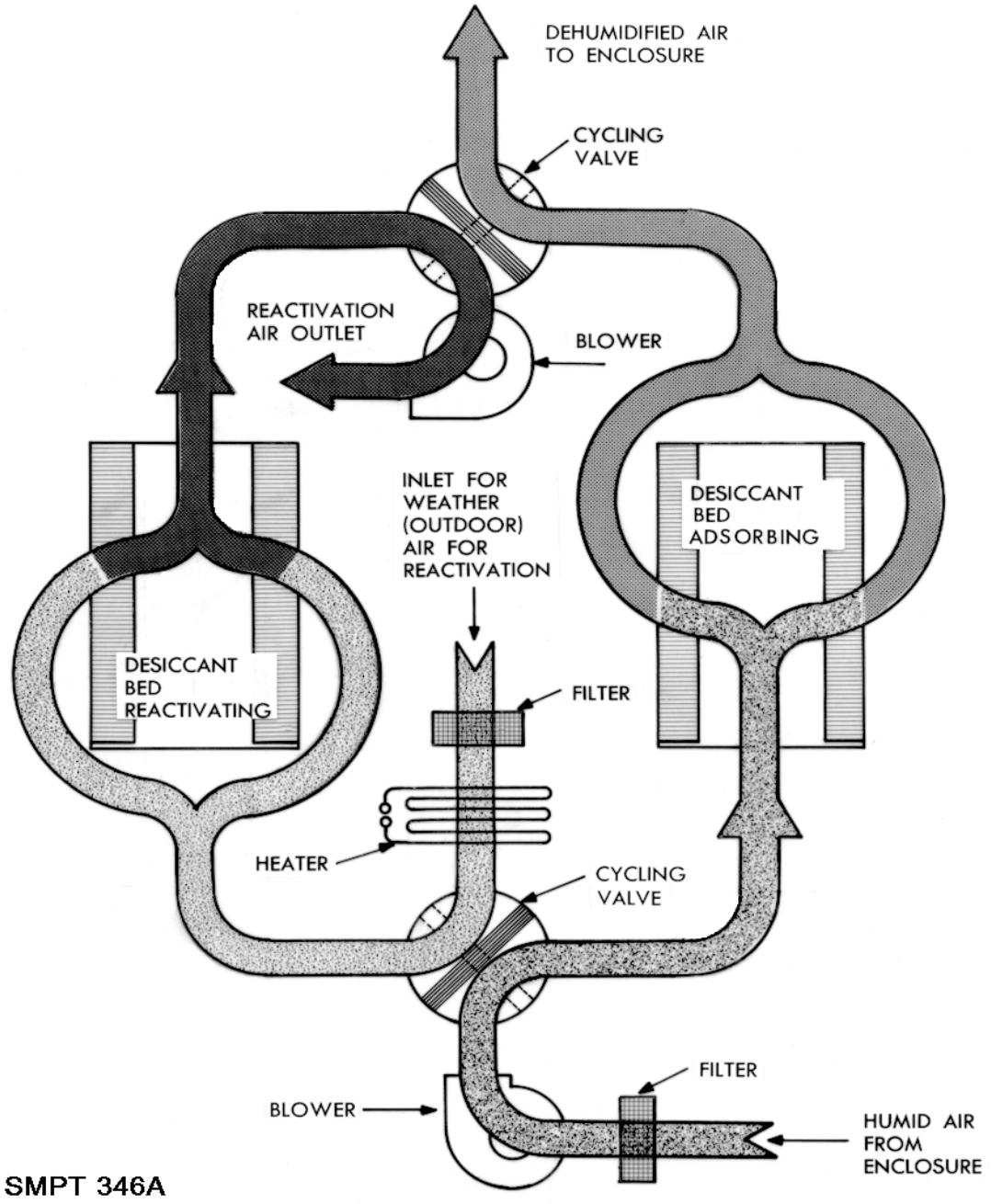

Figure 5-5. Flow diagram - dual bed desiccant dehumidifier.

Installation of Machines

Solid desiccant machines can be installed either inside or outside the dehumidified space. In either case, it is necessary to run two separate air ducts through the walls of the inclosure. When installed inside, the duct lines bring in and discharge outside weather air used in reactivation. When installed outside, the ducts bring and return storage air from the inclosure. Location of machine, inside or outside, should be so that dry air is returned to the coldest part of the dehumidified space (where relative humidity is the highest). Floor space is generally saved by outside installation. In some instances, installation of machines from suspended platforms has saved floor space in warehouses.

Equipment

Continuous duty, automatic desiccant dehumidifiers having capacities up to 15,000 cubic feet per minute may be procured under specification MIL-D-16886. These machines may be ordered for reactivation by electric, steam, or gas heat. Bulk desiccant to replace dirty or accidentally scorched material is obtainable under MIL-D-3716.

CONTROL AND RECORDING EQUIPMENT

Economical human hair element humidistats are generally used in military applications to control the on-off operation of dehumidification equipment. A continuous relative humidity and temperature record is usually provided by a recorder (figure 5-6). Because of the unpredictability of the calibrations of these instruments, their accuracy is periodically checked with a psychrometer and a psychrometric table. These devices operate as follows:

- X Humidity and temperature recording device. A continuous 7-day temperature and relative humidity recording device known as a hygrothermograph provides a weekly record of the quality of the dehumidified atmosphere being furnished and is also useful in adjusting the timing of the desiccant bed cycles. In this machine, two pens mark a spring-driven chart that makes one revolution each week. A human hair element moves one of the pens to record relative humidity; a bimetallic temperature element moves the other pen to record temperature. When either humidistats or hygrothermographs are removed from dehumidified inclosures to be checked, they should be carried in a box containing desiccant because the humidity in the outside weather air should cause the human hair element to elongate and might put the devices out of calibration.
- X Instrument checking. Humidistats and hygrothermographs are usually exchanged for fresh ones and taken to a test bench at least every 2 months. A standard method of obtaining a true relative humidity reading to check these devices is to use a psychrometric chart. There are vertical and horizontal lines on this chart for dry bulb temperatures and the difference between dry bulb temperatures and the difference between dry bulb and wet bulb temperatures. Curved lines which cross the intersection of appropriate vertical and horizontal lines indicate relative humidity. Accurate dry bulb and wet bulb temperatures are provided by an instrument called a psychrometer. The type psychrometer used for this purpose has a centrifugal blower which fans two thermometers, with one having a wick wetted bulb. The sling psychrometer used by the military to determine the feasibility to troop training on hot humid days does not give accurate wet bulb readings in dehumidified air.
- X Human hair humidistat. The humidistat element consists of one or more bundles of human hair, from 3 to 8 inches long. These hairs are clamped at both ends into yokes. Attached to the yokes are multiplying linkages and levers which move a contact in a switch. As the relative humidity of the storage atmosphere increases, the hairs elongate, thereby closing a circuit to turn the machine on when the relative humidity reaches a preset level. The hairs shrink as the relative humidity decreases, thus reversing the process. The position of the pivot points can be changed to adjust the instrument if contact is not being made at the correct relative humidity.

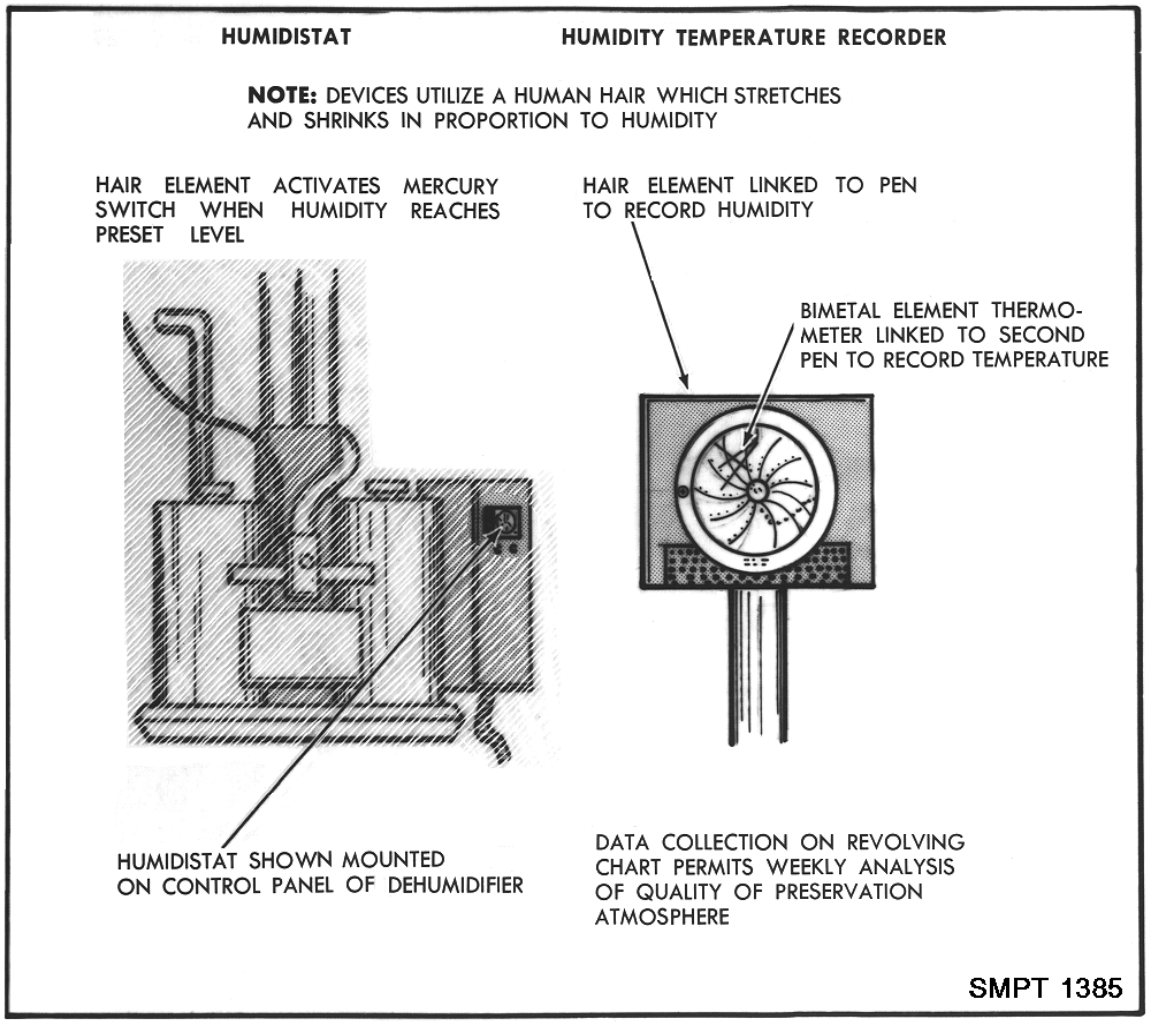

Figure 5-6. Relative humidity control and recording devices.

CONTROLLED HUMIDITY STRUCTURES

The general factors that determine the amount of watervapor that must be removed from an inclosure are

- X the daily entry of watervapor in the accompanying air from the outside and the process called “infiltration”
- X the daily entry of watervapor passing directly through construction materials and the process called “transmission”
- X the moisture contained in packing materials and skids are also a source of humidity that contributes to the need for dehumidification on a daily basis.

Infiltration

Controlled humidity storage structures should be caulked and closed tighter than normal structures to prevent infiltration of weather air and, if in active use, door openings must be rigidly controlled to prevent mass entry of weather air. However, structures must not be too tight or they might explode as inside air warms with heat from the sun through the roof. This necessary inward and outward flow of air through cracks and crevices with temperature changes is called breathing. To accommodate breathing, specifications for suitability of

outside structures for controlled humidity storage permit up to one complete turnover of air each 24 hours in a test where internal air pressure is raised to a point which is equal to a wind coming at the structure from the outside at 14 m.p.h. For comparison, maintenance of similar pressure conditions in an unprepared warehouse or ordinary factory building would produce 60 complete turnovers of air in 24 hours.

Transmission

The walls, roof, and floor of structures may be sealed with polyethylene, aluminum foil, paint, bituminous coating, or mastic topping to reduce watervapor transmission. Although air pressure remains the same on the outside as on the inside of a controlled humidity structure, there will be a great difference in watervapor pressures. Watervapor will leave outside air and pass directly through building materials to get to the area of lower watervapor pressure inside. In determining the suitability of structures for controlled humidity storage, daily load from watervapor transmission is estimated on the basis of the permeability of construction materials, their thicknesses, and sealing.

Dehumidification Load From Storage

In controlled humidity structures in active use, it has been estimated that 5 percent of the daily load of moisture which must be removed by dehumidifying machines results from drying out new storage. For instance, wood boxes and skids probably lose 7 percent of their weight in drying out. Once wood has been "brought down" in moisture content, it is a stabilizing factor in maintaining an even level of controlled humidity. See figure 5-7 which illustrates a theoretical, daily watervapor load in a dehumidified warehouse.

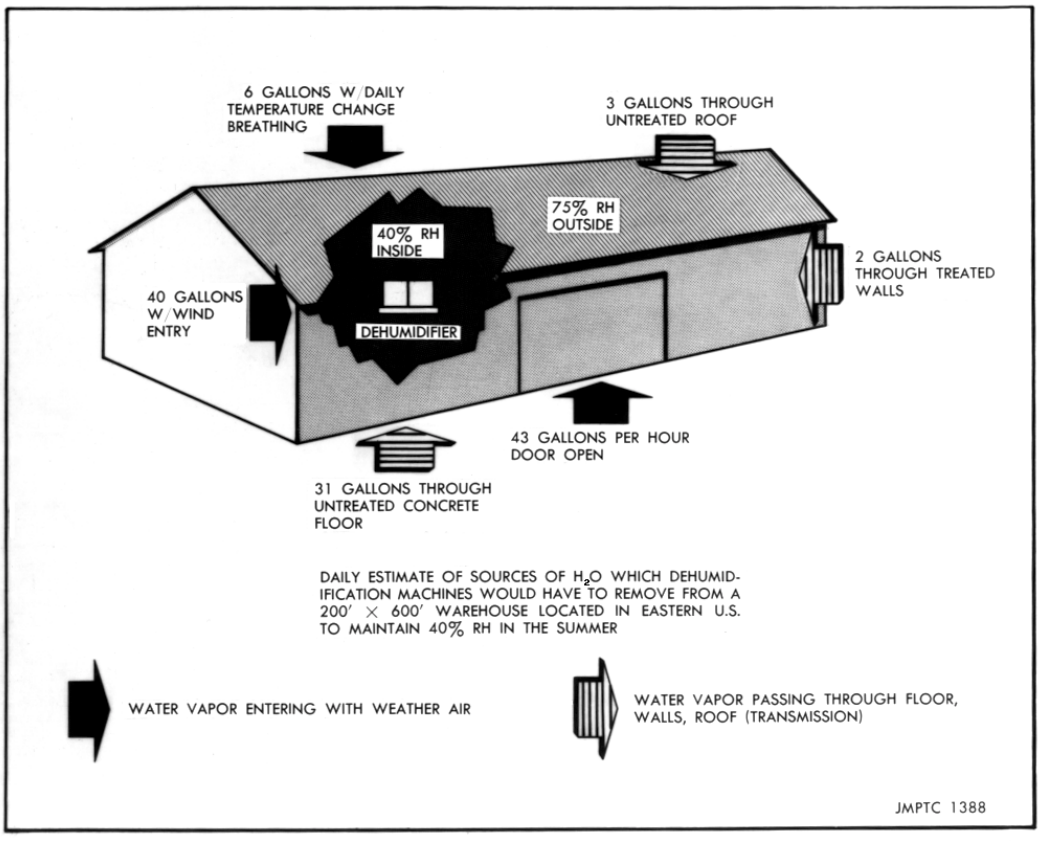

Figure 5-7. Example of daily watervapor load in a dehumidified warehouse.

APPLICATION OF CONTROLLED HUMIDITY STORAGE

The cost of providing preservation air through dynamic dehumidification has to be justified in the utilization of this type of storage. Some of the advantages in implications are as follows:

X Commercially packed material. Military supplies which have been packaged commercially are protected by corrosion control methods which are consistent only with limited tenure of storage; however, the supplies so protected may be stored for longer periods of time in controlled humidity storage.

X Level A and B - packed material. The more extensive corrosion control provided by levels A and B is extended in controlled humidity storage. For example, where desiccant in a Method 50 package might have to be replaced after extended conventional storage, it would probably still be near the beginning of its effective condition after extended controlled humidity storage. Periods between cyclic inspections may be lengthened for all levels of packing.

X Packing containers. If wood shipping containers are included in controlled humidity storage, it should be borne in mind they may be weakened by splitting around nails as shrinkage occurs. Strapping applied to wood shipping containers before controlled humidity storage will loosen as shrinkage occurs, usually to the point where it must be replaced before shipment.

X Machinery and equipment. Complicated machinery and heavy equipment, protected only by light oils and dust covers which permit the item to be readied for use without disassembly and removal of heavy preservatives, can be stored for indefinite periods of time in controlled humidity storage.

X Prepositioned material. There is a growing requirement for the indefinite storage of military supplies in prepositioned oversea locations and floating depots. This material can be maintained in nearly ready-for-issue condition in controlled humidity inclosures.

X Work in controlled humidity atmosphere. Working conditions, so far as the extent of dehumidification required for storage, may be considered desirable. Drier climates in the southwest are sought for their healthfulness. Reluctance of some operators to work in dehumidified areas may be due to experiences with dangerous concentrations of fumes from internal combustion forklifts which would have occurred in any warehouse where doors cannot be left open.

CHAPTER 6

Fiberboard and Paperboard Containers

INTRODUCTION

Containers are required in several of the MIL-STD-2073-1C preservation methods. Two of these methods specify a container-bag-container combination. MIL-STD-2073-1C allows the procuring agency to specify supplementary cartons, boxes, or other suitable containers with any method of unit protection to facilitate storage, handling and packing.

MIL-STD-2073-1C does not require containers which conform to any particular specification for the purposes stated in the preceding paragraph. The most common containers are fiberboard shipping boxes, folding paperboard boxes, set-up paperboard boxes, and paperboard metal edged boxes.

FIBERBOARD BOXES

GENERAL

The classification of fiberboard boxes is described in ASTM D4727, Standard Practice for Corrugated and Solid Fiberboard Sheet Stock (Container Grade) and Cut Shapes. Other standards and specifications, Government and non-Government references, regulating the use and shipment of fiberboard boxes are as follows:

ASTM Standards

X D685, Practice for Conditioning Paper and Paper Products for Testing.
X D996, Terminology of Packaging and Distribution Environments.
X D3950, Specification for Strapping, Nonmetallic.
X D3951, Practice for Commercial Packaging.
X D3953, Practice for Strapping, Flat Steel and Seals.

Federal Specifications and Standards

X MM-A-250, Adhesives, Water-Resistant (for Closure of Fiberboard Boxes).
X PPP-B-638, Packing of Boxes, Caps, Liners, and Sleeves.
X FED-STD-123, Marking for Shipment (Civil Agencies).

Military Standard

X MIL-STD-129, Marking for Shipment and Storage.

Code of Federal Regualtions

X Title 49 - Transportation.

Other Publications

X National Motor Freight Classification.
X Uniform Freight Code.
X Federal Food, Drug and Cosmetic Act.

ADVANTAGES

Fiberboard shipping boxes constructed in accordance with ASTM D 5118 using fiberboard conforming to the type, class, variety, and grade of ASTM D 4727, Standard Specification for Corrugated and Solid Fiberboard Sheet Stock (Container Grade) and Cut Shapes, offer the following advantages:

- X Two types of fiberboard (corrugated or solid) provide for a more rigid or a more resilient container. Both singlewall (SW) and doublewall (DW) varieties are available in the corrugated type.
- X A wide range of fiberboard grades (bursting strength in lb/in^2) allows economical application in a wide range of items of several weights and sizes.
- X Various box styles (designs) are available for the combination of type, variety, class, and grade of fiberboard selected. The regular slotted box (style RSC) is standard. It can be procured in as small a size as 4 X 4 inches for unit packing.
- X Prefabricated boxes are procured with only the *manufacturer's joint* stitched for flat shipment and storage. Assembly and closure are easy.
- X Hand-operated and automatic box making machines are available when local custom production from sheet stock is justified. Such equipment facilitates making economical nesting fits for container-barrier-container unit packs.
- X Interior pack marking can be neatly applied by practically all approved methods. Marking methods such as printing, lithographing, silk-screening, and photo marking should be considered at time of ordering boxes for large runs.
- X Unit or intermediate containers in bin storage are usually suitable for parcel post shipment without overpacking.

CLASSIFICATION

"Type, class, variety, and grade" of corrugated fiberboard (CF) and solid fiberboard (SF), figure 6-1, shows the two types and three varieties of fiberboard and figure 6-2 illustrates various flute (corrugation) arrangements.

Type-Corrugated Fiberboard (CF) is available in the following classes, varieties, and grades:

- X Class-Domestic
  - S Variety singlewall (SW) is available in the following grades (pounds per square inch bursting strength): 125, 150, 175, 200, 275, and 350.
  - S Variety doublewall (DW) is available in the following the grades: 200, 275, 350, 500, and 600.
  - S Variety triplewall is available in grade 1100.
- X Class-Weather-resistant.
  - S Variety singlewall (SW) is available in the following grades: V3c, W5c, and W6c.
  - S Variety doublewall (DW) is available in the following grades:
- X Class-Water and Watervapor Resistant (WWVR) is available in the following grades: V3c, WWVR, and W5c, WWVR.

Type-Solid Fiberboard (SF) is available in the following classes and grades:

- X Class-domestic is available in the following grades: 125, 175, 200, 275, 350, 500, and 600.
- X Class-weather-resistant is available in the following grades: V2s, V3s, V4s, W5s, and W6s.

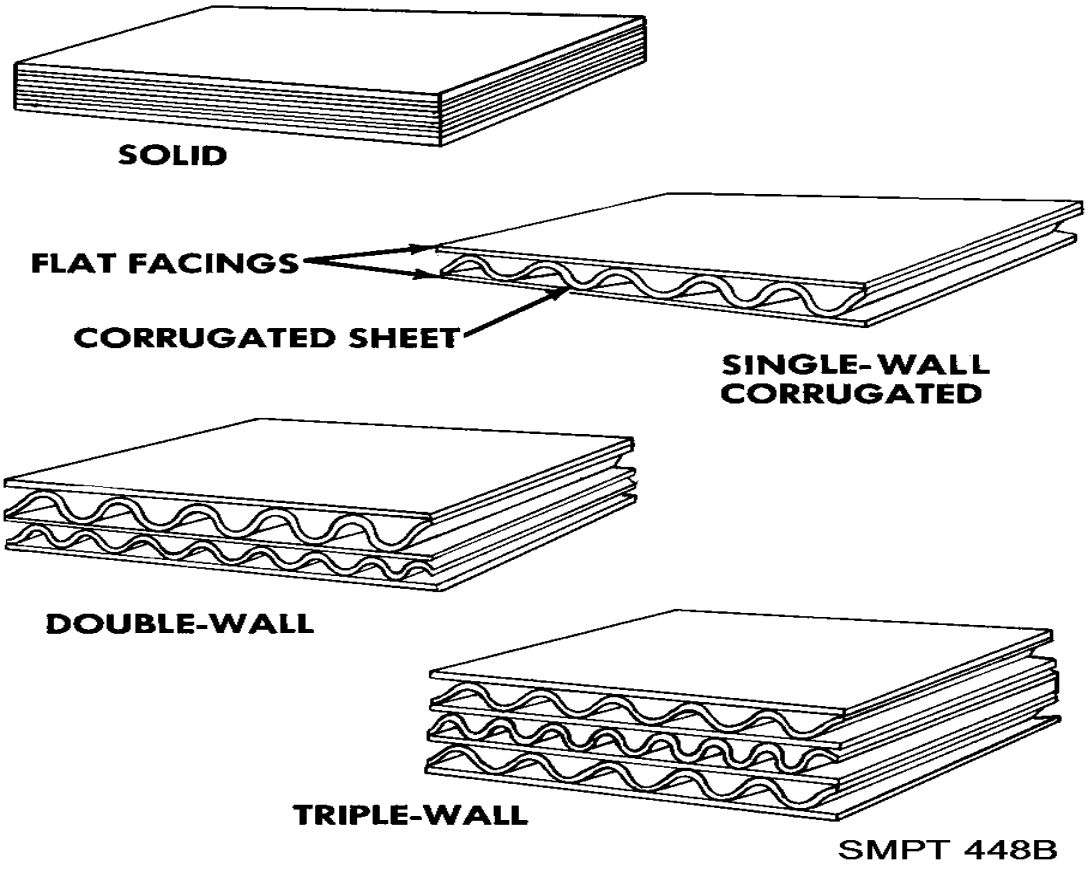

Figure 6-1. Types and varieties of fiberboard.

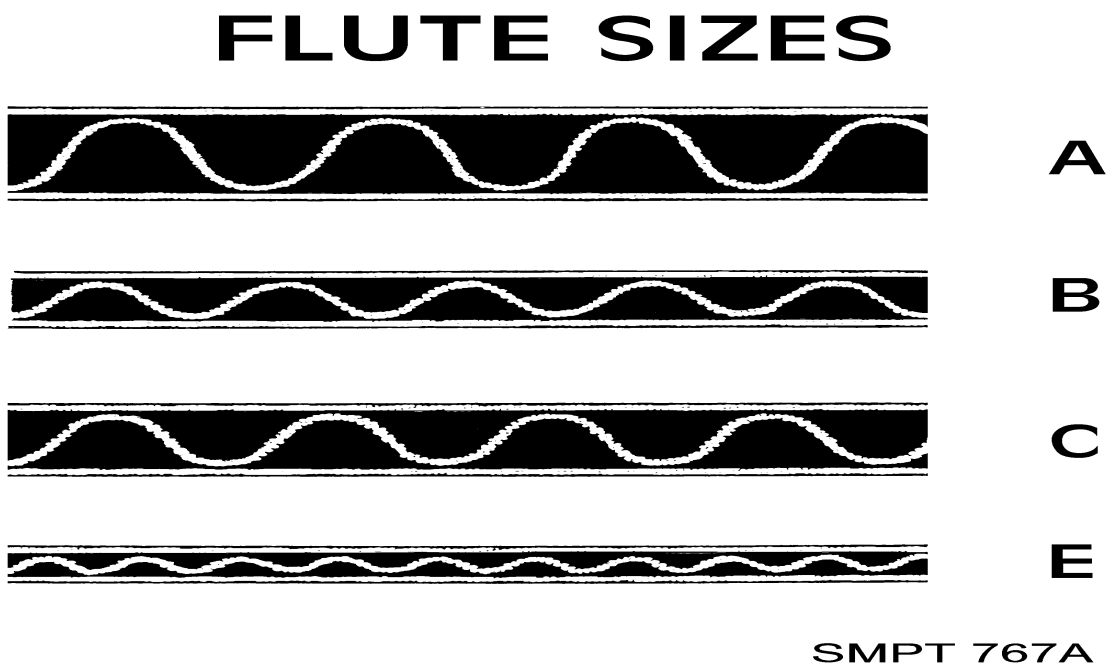

Figure 6-2. Corrugated fiberboard flutes.

STYLES OF FIBERBOARD BOXES

The styles shown in figures 6-3 and 6-4 are the basic styles of domestic and weather-resistant fiberboard shipping boxes. Additional styles may be found in ASTM D 5118.

Regular Slotted Box (RSC)

This box (the most commonly used style) is shown in figure 6-3. The box shall be scored and slotted to form a body piece having four flaps for closing each of two opposite faces. The flaps along the longer edge of the box openings are the outer flaps and those along the shorter edge are the inner flaps. Flaps shall not project beyond an edge of the box. All flaps shall be of equal length with the outer flaps meeting in the center of the width panel but not overlapping. The gap, not to exceed 1/4 inch, will be permitted unless otherwise specified.

Center Special Slotted Box (CSSC)

This box, shown in figure 6-3, shall be constructed the same as the RSC style, except that the length of the inner and outer flaps shall be such that they meet in the center of the box but do not overlap. A gap not to exceed 1/4 inch will be permitted.

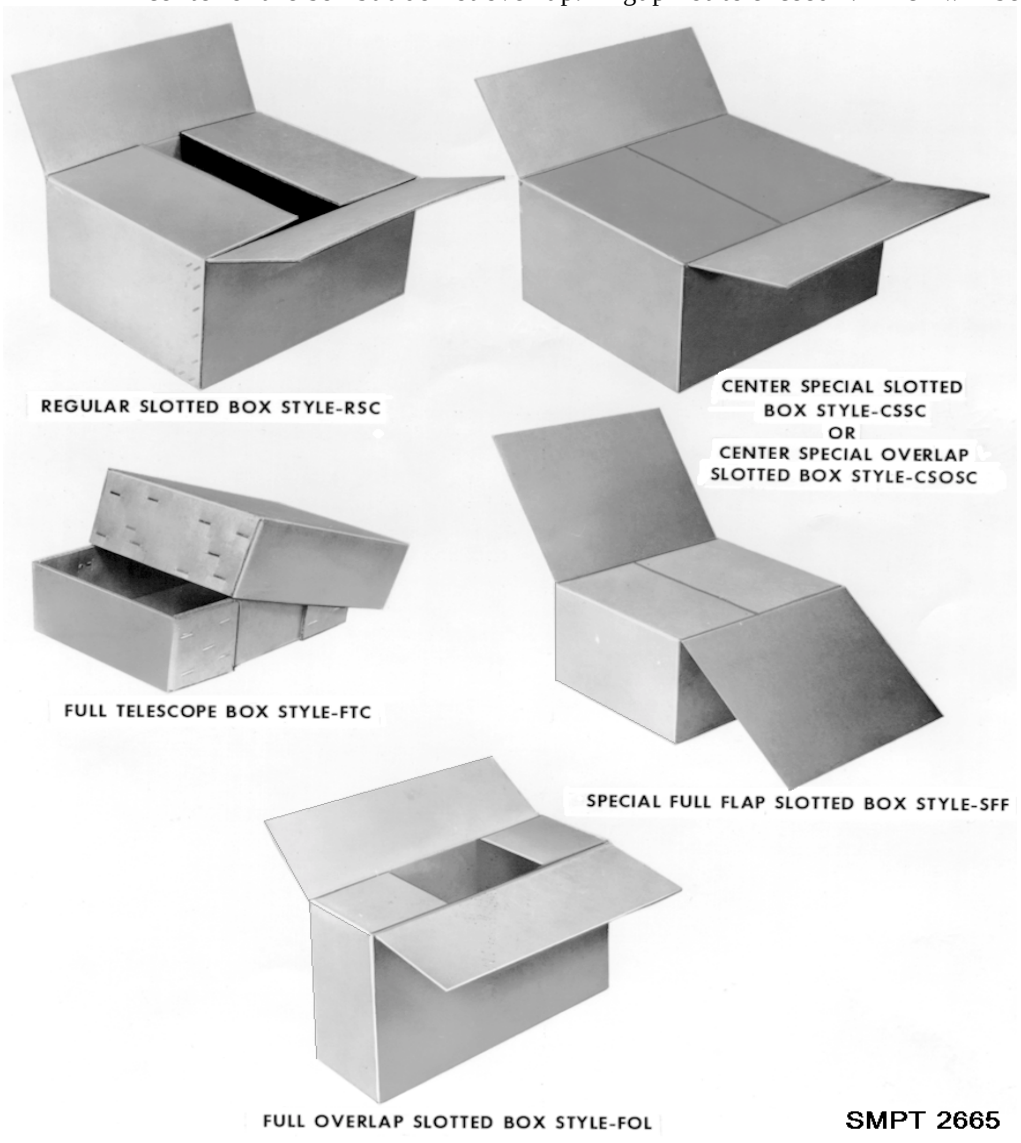

Figure 6-3. Styles of fiberboard boxes (1).

Full Telescope Box (FTC)

This box is shown in figure 6-3. The box consists of a body and a cover, each constructed of one piece of fiberboard, scored and slotted. The box dimensions shall be the inside measurements of the assembled box body. The cover shall be a snug fit on the body. When specified, flaps shall be positioned inside the side panels of the body and outside the end panels of the cover. When set up, the flaps shall not overlap but shall be of sufficient length to allow them to be securely fastened to the adjoining walls. One method to fasten the flaps to the walls is with not less than five staples applied per flap as illustrated in figure 6-3. When specified in the order, the flaps shall be inside the side panels of the body and outside the end panels of the cover. Unless otherwise specified in the order, the body and cover shall be shipped unassembled.

Overlap Slotted Box (OSC)

This box shall be as shown in figure 6-4. This box shall be scored and slotted to form a body piece having four flaps for closing each of two opposite faces. When closed, the inner flaps shall not overlap and the outer flaps shall overlap the distance specified in the purchase order. Inner flaps shall be the same length as the outer flaps, except where the relation of width to length would cause the inner flaps to overlap, in which case, the inner flaps shall be cut so that, when in closed position, they shall meet.

Special Full Flap Slotted Box (SFF)

This box shall be as shown in figure 6-3. This box shall be constructed the same as style OSC, except that the length of the inner flaps in the closed position shall be such that they meet in the center of the box but do not overlap. A gap not to exceed 1/4 inch will be permitted.

Full Overlap Slotted Box (FOL)

This box shall be as shown in figure 6-3. The box shall be constructed the same as style OSC, except that the length of the outer flaps shall be the full width of the box and shall not extend beyond the edge of the box by more than 1/8 inch.

One Piece Folder (OPF)

This folder shall meet the requirements shown in figure 6-4. The folder shall be constructed of one piece of fiberboard, scored and slotted as indicated in the referenced figure. When closed, outer flaps shall meet. A gap not to exceed 1/4 inch will be permitted. Unless otherwise specified, the inner flaps shall not be less than 2 inches long for folders under 18 inches in width and not less than 3 inches long for folders 18 inches and over in width.

Triple Slide Box (TS)

This box shall meet the requirements shown in figure 6-4. The box shall be constructed of three pieces of fiberboard scored to provide three tubes which, when assembled, completely cover six faces of the box. The inner tube shall be left open as illustrated. The middle tube shall be taped at the body joint and shall be a sliding fit on the assembled inner tube. The outer tube shall be taped at the body joint and shall be a sliding fit on the assembled inner and middle tubes. The box dimensions shall be the inside dimensions of the inner tube in the sequence of length, width, and depth and shall be as illustrated in the referenced figure. Corrugations shall be at right angles to the scoreline in each tube.

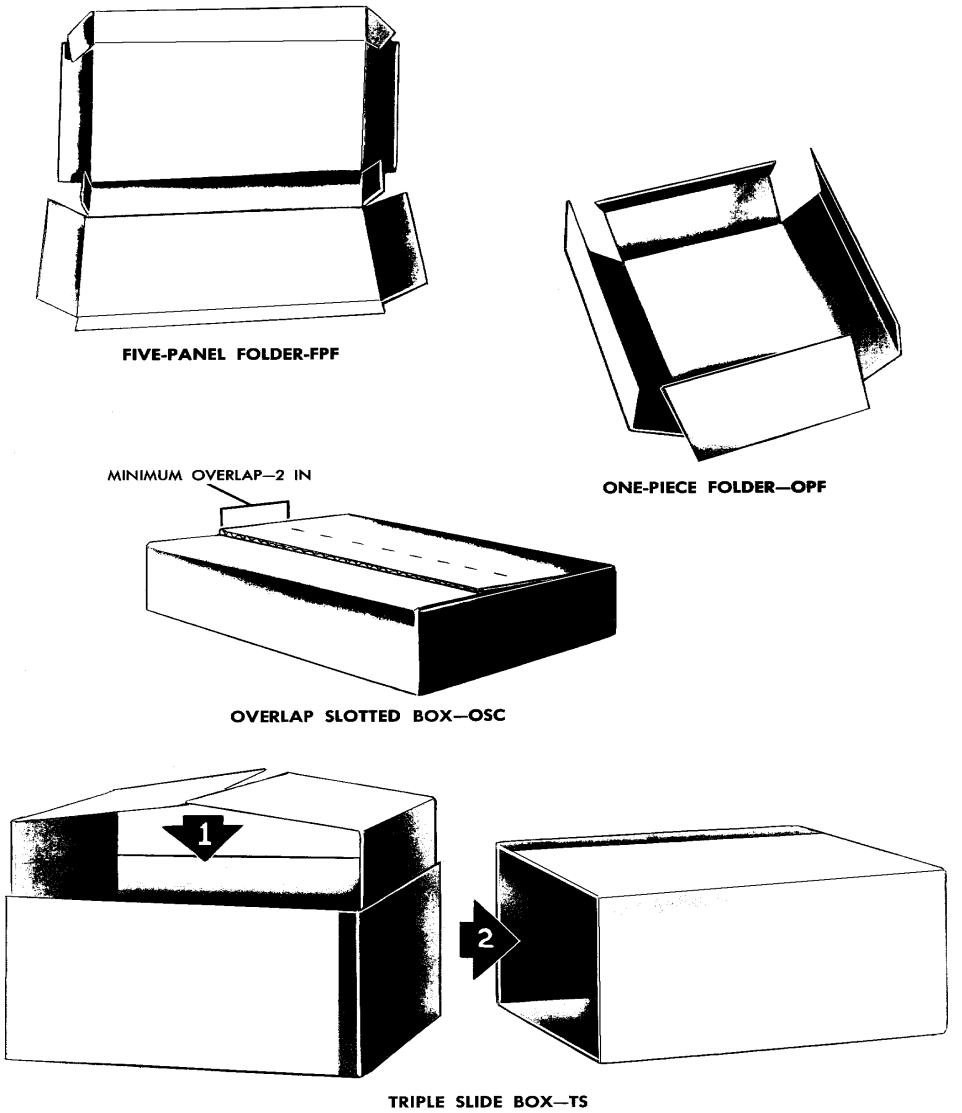

Figure 6-4. Styles of fiberboard boxes (2).

Five Panel Folder(FPF)

This folder shall meet the requirements shown in figure 6-4. The folder shall be scored and slotted as indicated in the referenced figure. When set up, outer flaps shall overlap (full overlap). The tuck flap (shown at the top and bottom of the box in figure 6-4) length shall be equal to the length of the side panel less 1/4 inch plus or minus 1/8 inch.

REINFORCEMENTS

Sleeves

When specified in the order, sleeves shall be constructed from fiberboard as specified. If butt joint, it may be taped, or the overlap joint may be stapled, stitched or glued (see figure 6-5). Alternatively, the location of the body joint shall be in the center of the top or bottom panel, providing the joint does not interfere with the required marking. The sleeves shall fit closely over the top, bottom and end panels of the box for which it is intended. Space between the sleeve and box shall not

exceed 3/16 inch when opposite surfaces of sleeves and box are in direct contact with each other.

Liners

When specified in the order, liners shall be constructed from fiberboard as specified and as shown in figure 6-6. The liner shall be scored to cover the end and side panels of the box for which it is intended. The flutes of the liner shall be perpendicular to the top of the box. Unless otherwise specified in the order, the height of the liner shall be the full inside depth of the box for which intended, and the ends of the liner shall abut (gap not to exceed 1/8 inch) in the center of a side panel of the box.

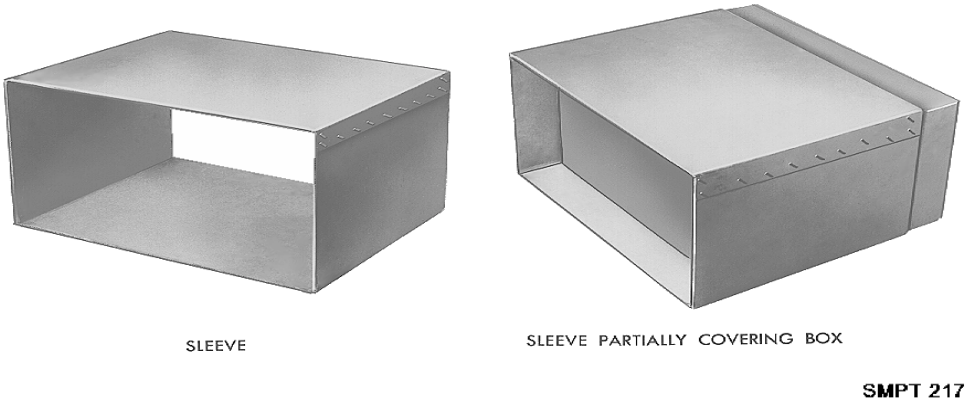

Figure 6-5. Use of a fiberboard sleeve.

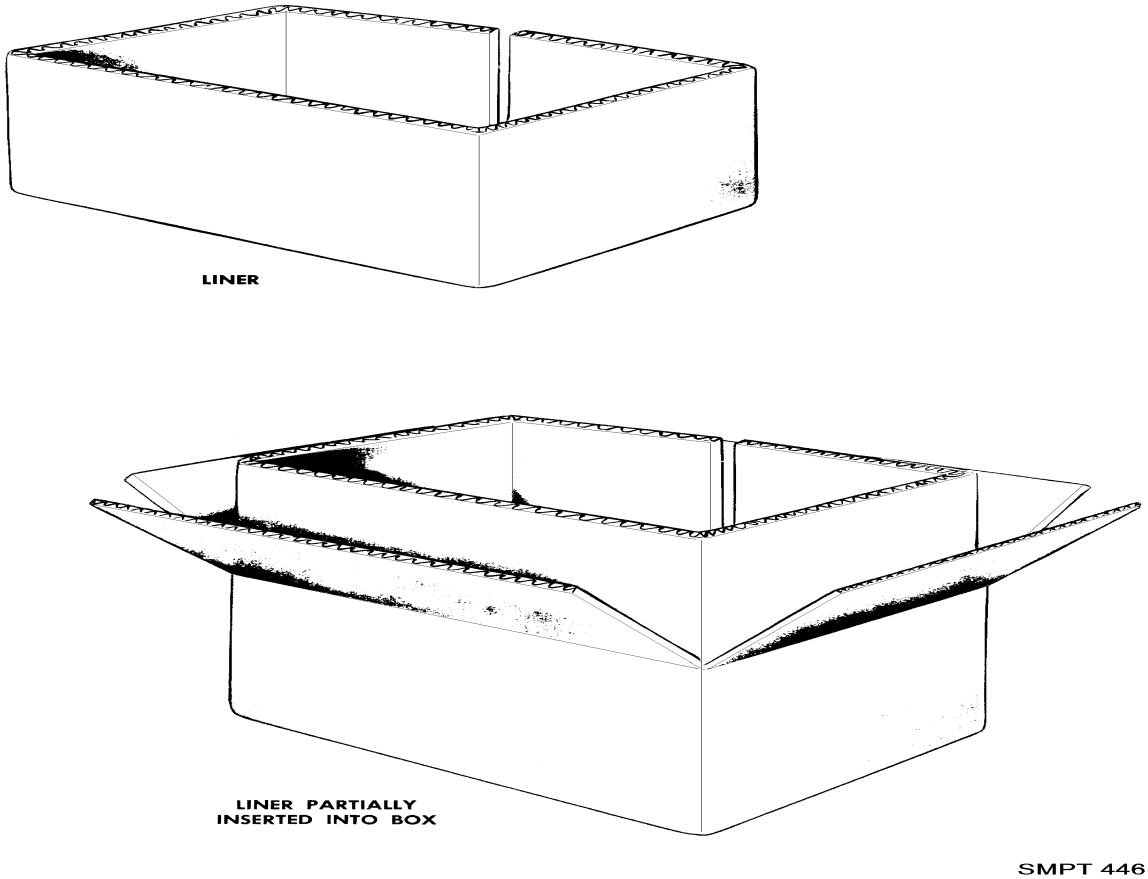

Figure 6-6. Use of a fiberboard liner.

FABRICATION OF BOXES

Cutting, Scoring and Slotting

Special machines are used to cut, score and slot the fiberboard material so that it can be made into a box.

Manufacturer's Joint

Figure 6-7 illustrates several methods to fasten body joints of fiberboard boxes.

Class Weather-Resistant and WWVR Boxes

The joint of type CF and SF boxes shall be a fiberboard overlap not less than 1.5 inches wide extending the full inside depth of the box. The joint shall be fastened either inside or outside the adjoining panel. The overlap joint shall be secured with metal fasteners (see figure 6-7) spaced not more than 2 inches apart, center to center, and the distance between the ends of the joint and the nearer end of the fastener shall not exceed 1 inch. When specified, the joint may be glued or butted (see ASTM D 5228 for instructions).

Class domestic boxes

The joint of type CF, variety SW box shall be overlapped or butted. The joint of the type SF shall be overlapped. The joint of the type CF, variety DW box, shall be overlapped or butted. Large boxes may be fabricated with two joints positioned at diagonally opposite corners at the option of the supplier. The overlapped joint (joint tab) shall be made not less than 1.25 inches wide with the length of the overlap equal to the inside depth of the box. The joint tab shall be fastened either inside or outside the adjoining panel. Metal fasteners for the type CF and type SF boxes having a depth dimension of 18 inches or less shall be spaced not more than 3 inches apart, center to center. Metal fasteners for the SF box having a depth dimension greater than 18 inches shall be spaced not more than 2.5 inches apart, center to center. The distance between the ends of the joint and the nearer end of the nearest fastener shall not exceed 1 inch. For other means of fastening joints, see ASTM D 5118.

COMPLIANCE MARKING

Types CF and SF, Class Weather-Resistant and WWVR Boxes.

These boxes shall be imprinted with the following data (see figure 6-8):

- X Boxmaker's name or boxmaker's certificate.
- X Month and year of manufacturer (for example, "6-93").
- X Individual grade or identification symbols.
- X Specification compliance data, specification number, and minimum average bursting strength of ___psi.
- X For shipments to Government agencies the national stock number (NSN), inside dimensions, and outside cube shall be marked below the specification data on all exterior type boxes procured as an item of supply.

Type CF and SF, Class Domestic Boxes

Each box shall be plainly marked with the appropriate boxmaker's certificate signifying compliance with the National Railroad Freight Classification rules and the National Motor Freight Classification rules, as applicable. The certificate may be located on the box wherever it is customarily placed; however, the preferred location is on the bottom panel or bottom outer flap.

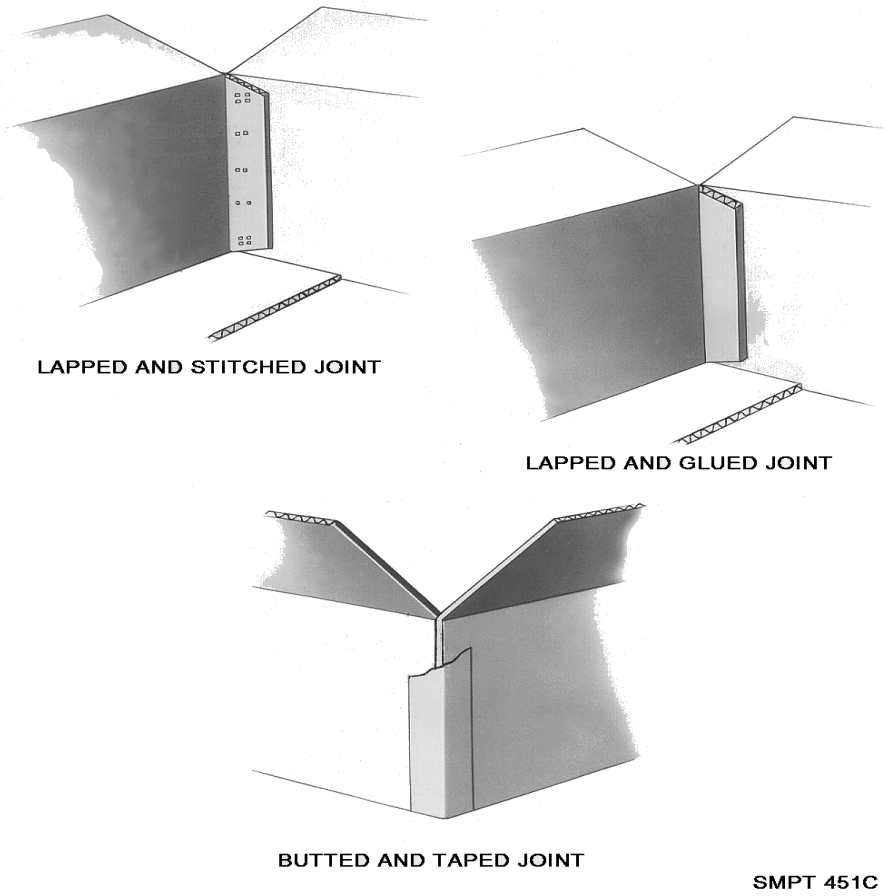

Figure 6-7. Body joints for fiberboard boxes.

WORKMANSHIP

The completed box shall be clean, free of frayed or torn edges, improperly aligned panels, improper scores and slots, and the marking shall be clear and legible. All dimensions of the boxmaker's blank shall be accurately cut, scored, and slotted so that the assembled box parts fit closely without binding. No flap shall project beyond an edge of a box by more than 1/8 inch when the box is set up and closed. All metal fasteners shall be well clinched, flush with or below the interior and exterior surfaces of the corrugated fiberboard joint, and shall be flush or slightly above the surfaces for solid fiberboard.

CLOSURE

ASTM D 1974, Standard Practice for Methods of Closing, Sealing, and Reinforcing Fiberboard Boxes, describes several methods for closing, sealing, and reinforcing fiberboard (solid or corrugated) boxes used for shipment. One of several methods listed in ASTM D 1974 may be referenced in regulations, specifications, or contracts.

Over one hundred closure methods for fiberboard boxes are described in ASTM D 1974. It is recommended that you obtain a copy of ASTM D 1974 for detailed information on the closure of fiberboard boxes.

Figure 6-9 illustrates fiberboard boxes closed with adhesives, tape, or stitches.

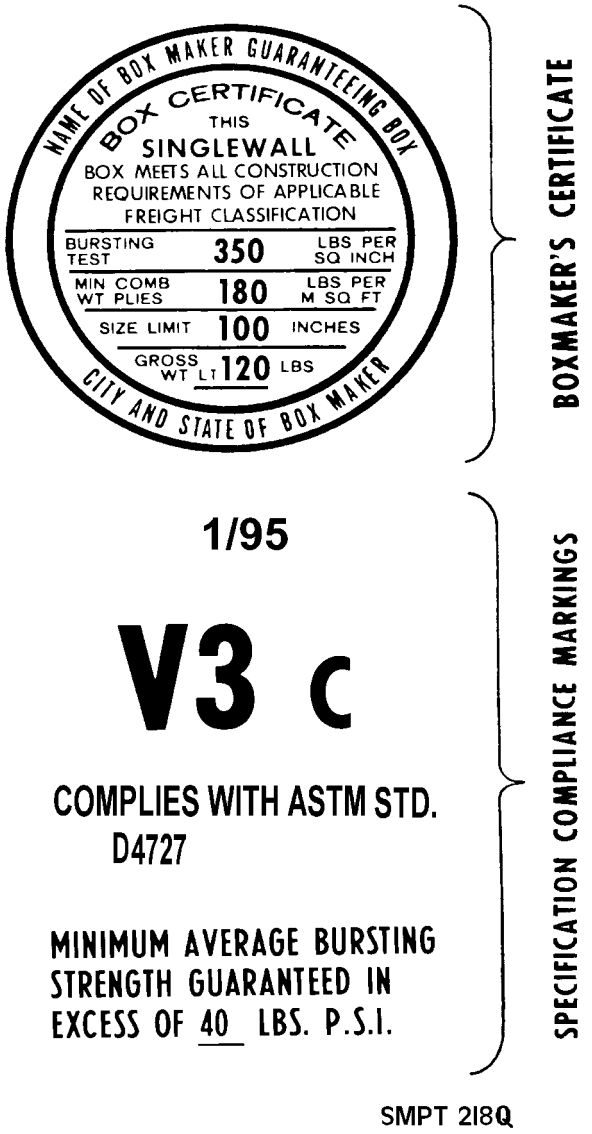

Figure 6-8. Sample (circular) box maker's certificate and compliance statement.

Use of Adhesive

Adhesive that meets the requirements of MMM-A-250, Adhesive, Water-resistant (for Closure of Fiberboard Boxes), is applied to both bottom and top flaps over the entire area of contact between the inner and outer flaps. Weights are usually necessary to keep the flaps down until the adhesive dries.

Semi-automatic and fully automatic box closure equipment is available for the application of adhesives. Hot melt adhesives are also applied by hand held "guns". Adhesives work best on clean, dry surfaces. It is important to have the box flaps held in place until the hot melt adhesive solidifies or the waterborne adhesive develops sufficient bond.

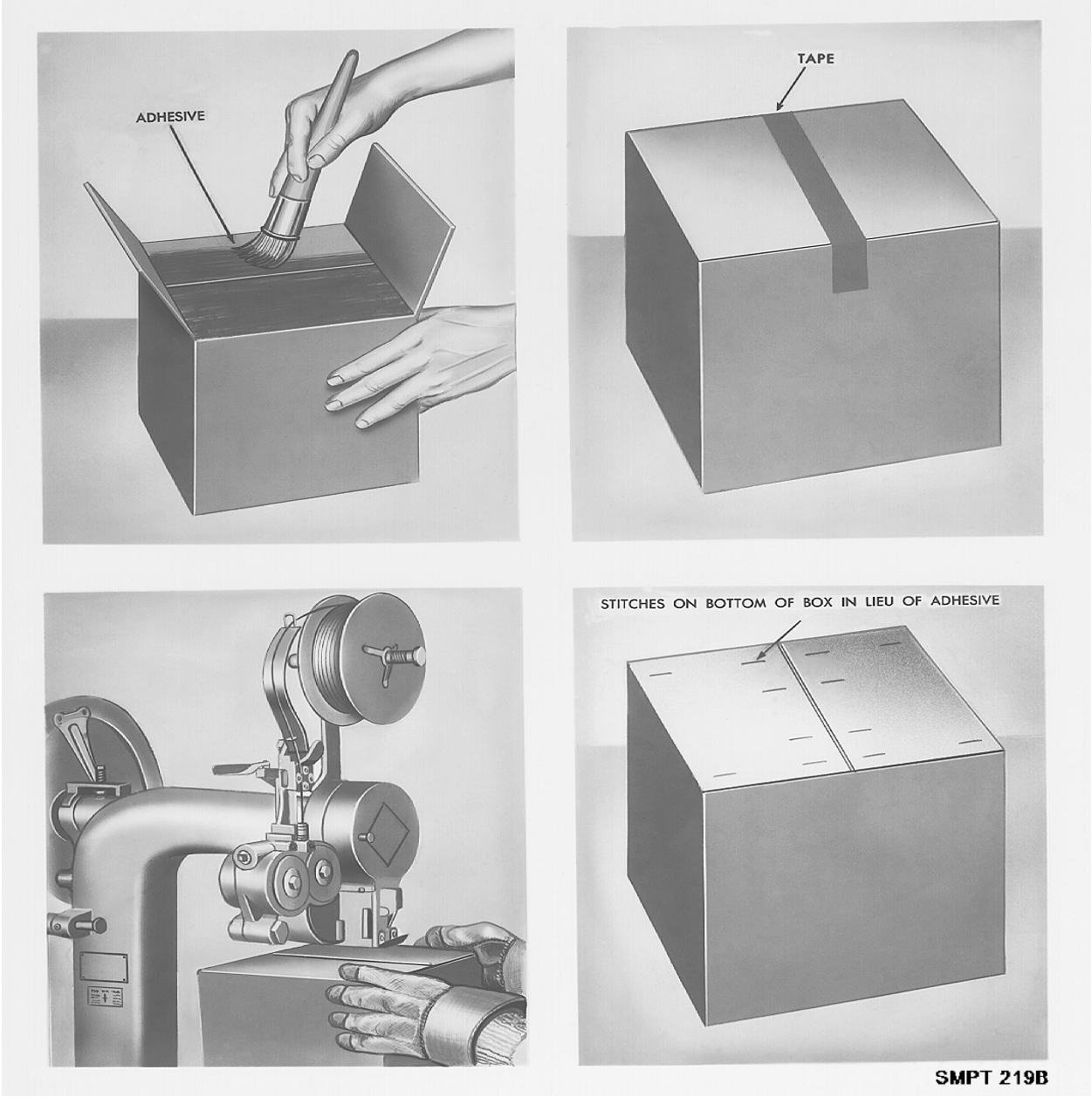

Figure 6-9. Closure of fiberboard boxes with adhesives, tapes or stitches.

Combination of Stitches and Adhesive

The bottom set of flaps is stitched prior to packing. The number of stitches to be used is based upon the inside width of the box in inches. When stitching the bottom flaps, half of the stitches or staples will pass through each of the inner flaps and be distributed in such a manner as to fasten all flaps together over the entire area of contact between inner and outer flaps. This is to prevent the lifting of free edges and corners. After packing, the other set of flaps (top of the box) is sealed with MMM-A-250 adhesive in the same manner described in the preceding paragraph.

Pressure-Sensitive Tape

Taping of RSC and similar styles, which are to be overpacked for shipment, may, when specified, have the box closed with 2-inch wide paper tape applied over the center seams of the box, continuing at least 2 inches onto the box ends. The tape

shall comply with CID A-A-1683; CID A-A-884 (tan); or CID A-A-1830 (transparent), Type III, Class 1 or 2; or 3-inch wide reinforced gummed tape applied over the center seams of the box, continuing at least 2.5 inches onto the box ends. The gummed tape shall comply with CID A-A-1671 (asphaltic) or CID A-A-1672 (nonasphaltic). Figure 6-9 shows a style RSC fiberboard box closed by this method. Figure 6-10 shows a nonslotted class weather-resistant fiberboard box closed with tape.

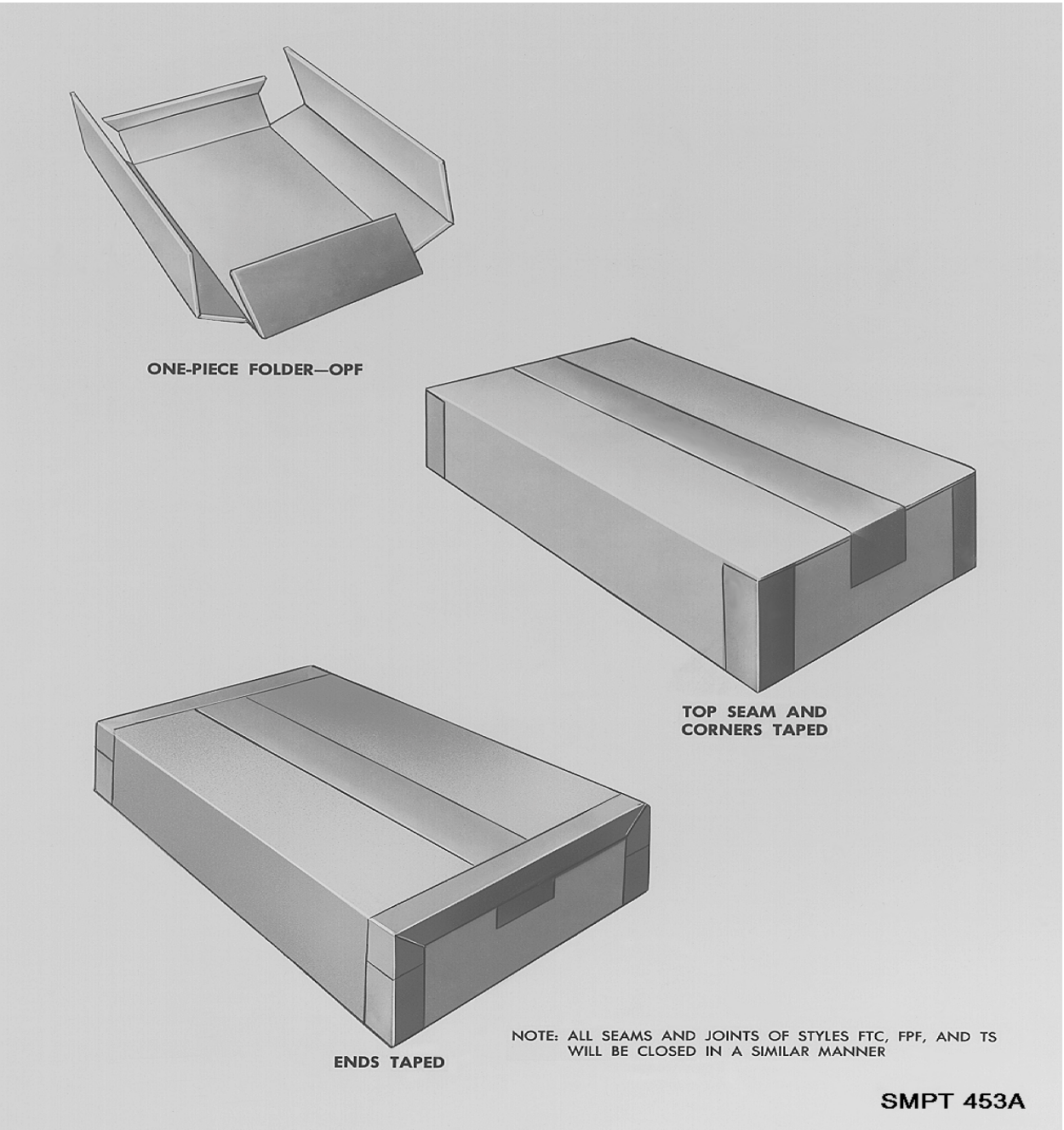

Figure 6-10. Closure of nonslotted class weather-resistant fiberboard box with tape.

METHODS OF WATERPROOFING

Although both V-board and W-board are highly water-resistant, boxes made from these materials will permit the entrance of water through the corners and joints. When packed items are of such a nature as to be damaged by water, waterproofing is provided by the use of individual wraps of material conforming to PPP-B-1055 or MIL-B-13239 (figure 6-11); by the use of caseliners conforming to MIL-L-10547; or by the use of waterproof, pressure-sensitive tape conforming to ASTM D 5486 (formerly PPP-T-60 or PPP-T-76), applied as shown in figure 6-12.

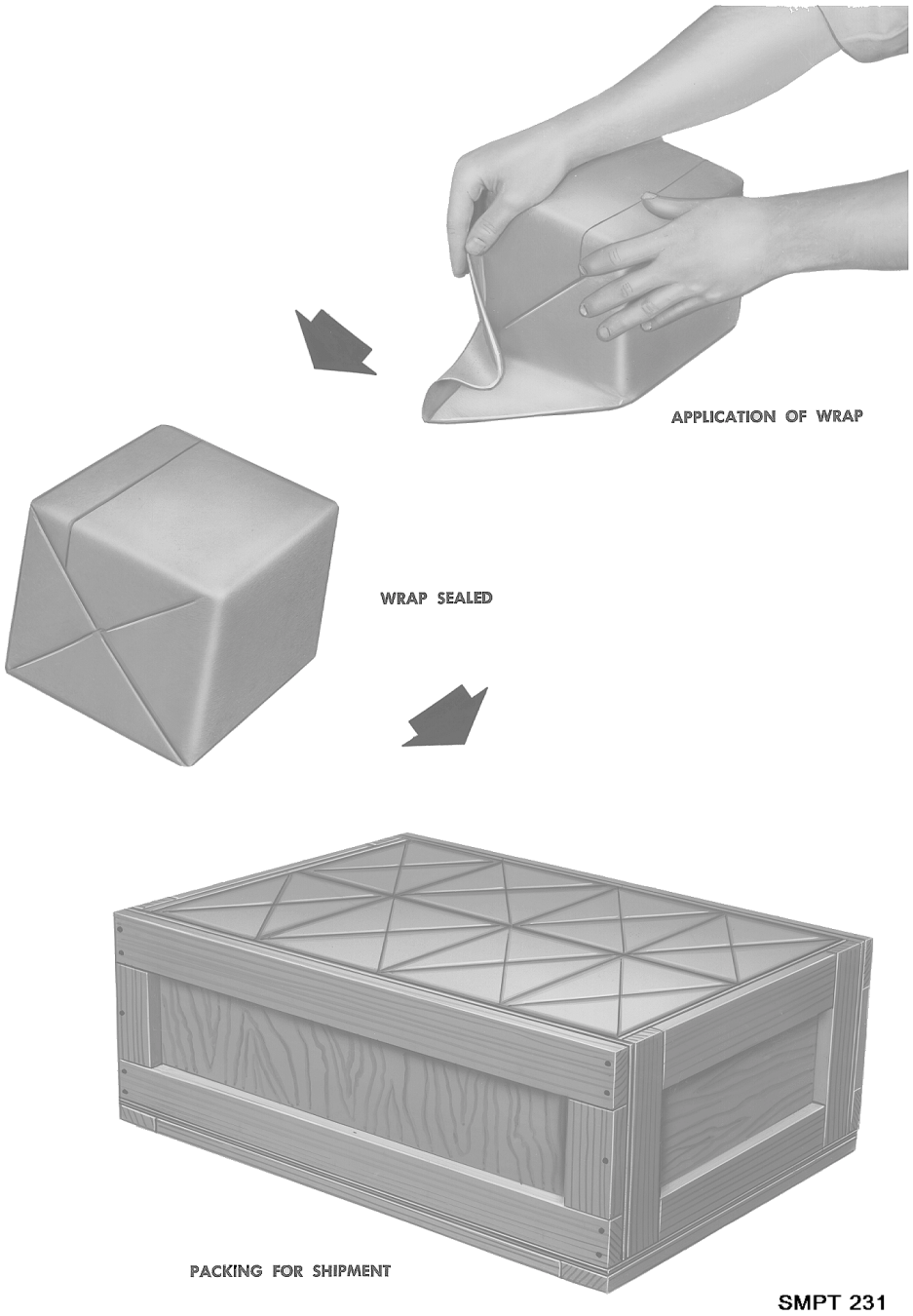

Figure 6-11. Waterproofing of individual packages.

Figure 6-12. Waterproofing fiberboard boxes with tape.

SIZE AND WEIGHT LIMITS

Size and weight limitations for fiberboard boxes are tabulated in ASTM D 5118.

Weight Limitations for Types CF and SF Class Domestic Fiberboard Boxes

The weight limit range (maximum weight of box and contents) for types CF and SF class domestic fiberboard boxes is 125 to 600 pounds, depending on the grade and size of the box. For example, grade 275 having inside dimensions (length + width + depth) of 90 inches would have a weight limit of 90 pounds.

Weight Limitations for Class WR and WWVR Fiberboard Boxes Used as Exterior Containers

The weight limit range (maximum weight of box and contents) for these boxes is 30 to 160 pounds, depending on the grade and size of the box. For example, grade W5s having inside dimensions (length + width + depth) of 75 inches would have a weight limit of 65 pounds.

PAPERBOARD CONTAINERS

DESCRIPTION

Paperboard containers, in the form of folding or set-up boxes, are fabricated with automatic machines and delivered to the user in a flat, collapsed, or set-up form, ready for mechanical or hand assembling and use. Procurement of the boxes must be made from qualified manufacturers.

INTENDED USE

The articles normally packed in folding or set up boxes are classed as supporting loads (type 1 load), semi-supporting loads (type 2 load), and nonsupporting loads (type 3 load). The maximum weight of the load should not exceed 10 pounds.

Supporting Load

A supporting load is a rigid and rectangular product which completely fills and fully contacts and supports all the interior surfaces of the container. The following are examples of supporting loads:

- X A rectangular bar of soap.
- X Books and other printed matter.
- X One or more rectangular inner packs.

Semi-Supporting Load

This load is a rigid or semirigid product which contacts and supports at least some portions of all the interior surfaces of the container. Examples of supporting loads are as follows:

- X One or more cylindrical cans, jars, or bottles.
- X Automotive or airplane parts.
- X Small arms ammunition.

Nonsupporting Load

A nonsupporting load is a flexible, powdered, flaked, crystalline, or odd-shaped product which either results in a concentrated load or does not contact and support all interior surfaces of the container. The following are examples of products meeting the definition of nonsupporting loads:

- X Flour, sugar, soap powders, etc.
- X Odd-shaped parts.
- X Semisolids such as butter and lard.
- X Soft line clothing items, such as socks, underwear, etc.

FOLDING PAPERBOARD BOXES (PPP-B-566)

GENERAL REQUIREMENTS

Folding boxes will conform to the requirements of PPP-B-566. These boxes are made of good quality bending paperboard of a thickness between 0.012 to 0.045 inch. The paperboard, when scored, will withstand folding to 180 degrees without visible cracks or fractures on the outer surface. When greater than normal strength is required, the paperboard must possess specified bursting strength values.

CLASSIFICATION

There are four varieties and many styles, types, and classes, as well as some subclasses of folding boxes suitable for unit packing or segregation of small items of supply. (See figures 6-13, 6-14, and 6-15).

Varieties and Processes

Variety 1 and variety 2 consist of nonresistant paperboard and water resistant paperboard, respectively. Variety 3 is grease resistant, and variety 4 is water and grease resistant. The water resistant variety is available in the following processes:

- X Process I - Coated on one side, with the resistant surface on the inside.
- X Process II - Coated on both sides.

Styles, Types, Classes and Subclasses

Table 6-1 shows the breakdown of styles, types, classes and subclasses of PPP-B-566 boxes.

Table 6-1. Styles, types, and classes of PPP-B-566 boxes

Style I - Seal end (figure 6-13)	Type A - Outer flaps full overlap.	Class a - Inner flaps at random, but not overlapping. Class b - Inner flaps meeting minus 1/4 inch tolerance.
	Type B - Outer flaps meeting minus 1/16 inch tolerance.	Class a - Inner flaps at random, but not overlapping. Class b - Inner flaps meeting.
	Type C - Self-sealing.	Class c - single sealed ends. Class d - Double sealed ends.
Style II - Tuck end (figure 6-13)	Type D - Reserve tuck.	Class a - Inner flaps at random. Class e - Inner flaps specified
	Type E - Straight tuck.	Class a - Inner flaps at random. Class e - Inner flaps specified.
Style III -Brightwood blank (figure 6-13)	Type F - One piece with cover attached.	Class f - No dust flaps. Class g - Dust flaps on side panel. Class h - Dust flaps on cover.
	Type G - Two-piece.	Class I - Full telescope. Class j - Partial telescope. Subclass 1 - No turnover on sides or ends. Subclass 2 - With or without turnover on sides or ends. Depth of lid specified.
	Type H - One-piece tray.	Not applicable.
Style IV - Overlapping end wall (with or without double side walls) (figure 6-13)	Type I - Two-piece hardware lock.	Class I - Full telescope. Class j - Partial telescope. Class k - One-piece tray.
	Type J - Two-piece friction end.	Class I - Full telescope. Class j - Partial telescope. Class k - One-piece tray.
Style V - Cracker style lock end (figure 6-14)	Not applicable.	Not applicable.
Style VI - Tube and slide (figure 6-14)	Not applicable.	Not applicable.
Style VII - One-piece folders (figure 6-14)	Not applicable.	Not applicable.
Style VIII - Diagonal folds (figure 6-14)	Type F - One-piece cover attached	Class f - No dust flaps. Class g - Dust flaps on side panel. Class h - Dust flaps on cover.
	Type G - Two-piece.	Class I -Full telescope. Class j - Partial telescope.
	Type H - One-piece tray.	Not applicable.
Style IX - Double lock-end top and bottom (figure 6-15)	Not applicable.	Not applicable.
Style X - Snap lock bottom with tuck top (figure 6-15)	Not applicable.	Not applicable.
Style XI - Automatic fold, bottom and side glued (figure 6-15)	Not applicable.	Not applicable.
Style XII - Center support for rolls of tape (figure 6-15)	Type K - One-piece sleeve.	Class 1 - For widths of rolls up to and including 1 inch. Class m - For width of rolls up to and including 3 inches. Class n - For widths of rolls up to and including 4 inches.
Style XIII - Hinged, full depth cover with window	Not applicable.	Not applicable.
Style XIV - Double lock-end top and bottom	Not applicable.	Not applicable.

CLOSURE

Unless otherwise specified, the type of closure will be indicated by the style of the box. Locks provided for box closures will be carefully and securely assembled. When specified, telescopic styles will be closed by means of tape meeting the requirements of A-A-1492, A-A-1671, or ASTM D 5486. The tape is used to seal and strengthen the box. The amount of tape used and its application is dependent upon the nature of the contents. Under some conditions, it will be sufficient to apply a small piece of tape to overlap the closure by 1 inch. In other instances, where the contents are heavy, it may be necessary to run the tape entirely around the container.

USE

Only those articles which are not easily susceptible to damage which might be caused by ordinary distortion of the box, resulting from external forces during shipment, should be packed in folding paperboard boxes. These boxes are generally used for unit and intermediate packing. Normally, the weight of contents for these boxes is limited to 10 pounds. However, when in the judgement of the supervisor or other authority they are adequate for heavier loads, they may be so used. The resistant variety boxes are intended for use in packing items coated with oil or grease, for retaining the moisture content of the item packed, or for both, as applicable. Resistant variety boxes are not intended to be weatherproof.

SETUP BOXES (PPP-B-676)

DESCRIPTION AND CLASSIFICATION

Setup boxes are manufactured from nonbending paperboard. PPP-B-676 covers the requirements for new paperboard setup boxes and for closures of filled boxes. Setup boxes shall be of the types, varieties, classes, and styles as specified in table 6-2, as shown in 6-16 and 6-17.

Table 6-2. Classification of setup boxes (PPP-B-676)

Types (see figure 6-16)
I - Full telescope.
II - Partial telescope or shallow lid.
III - Neck or shoulder.
IV - Slide boxes.

Varieties
1 - Plain.
2 - Water resistant.
3 - Grease resistant.
4 - Water and grease resistant.
5 - Plain fire retardant.
6 - Water resistant and fire retardant.
7 - Grease resistant and fire retardant.
8 - Water and grease resistant-fire retardant.

Classes
A - Blank, corner stayed.
B - Blank, corners stitched or glued.
C - Blank, corners cut without stays.
D - Blank, end set.
E - Blank, bottom set.

Styles (see figure 6-17)
1 - Banded or strip stayed.
2 - Trimmed.
3 - Strip covered.
4 - Tight wrapped.

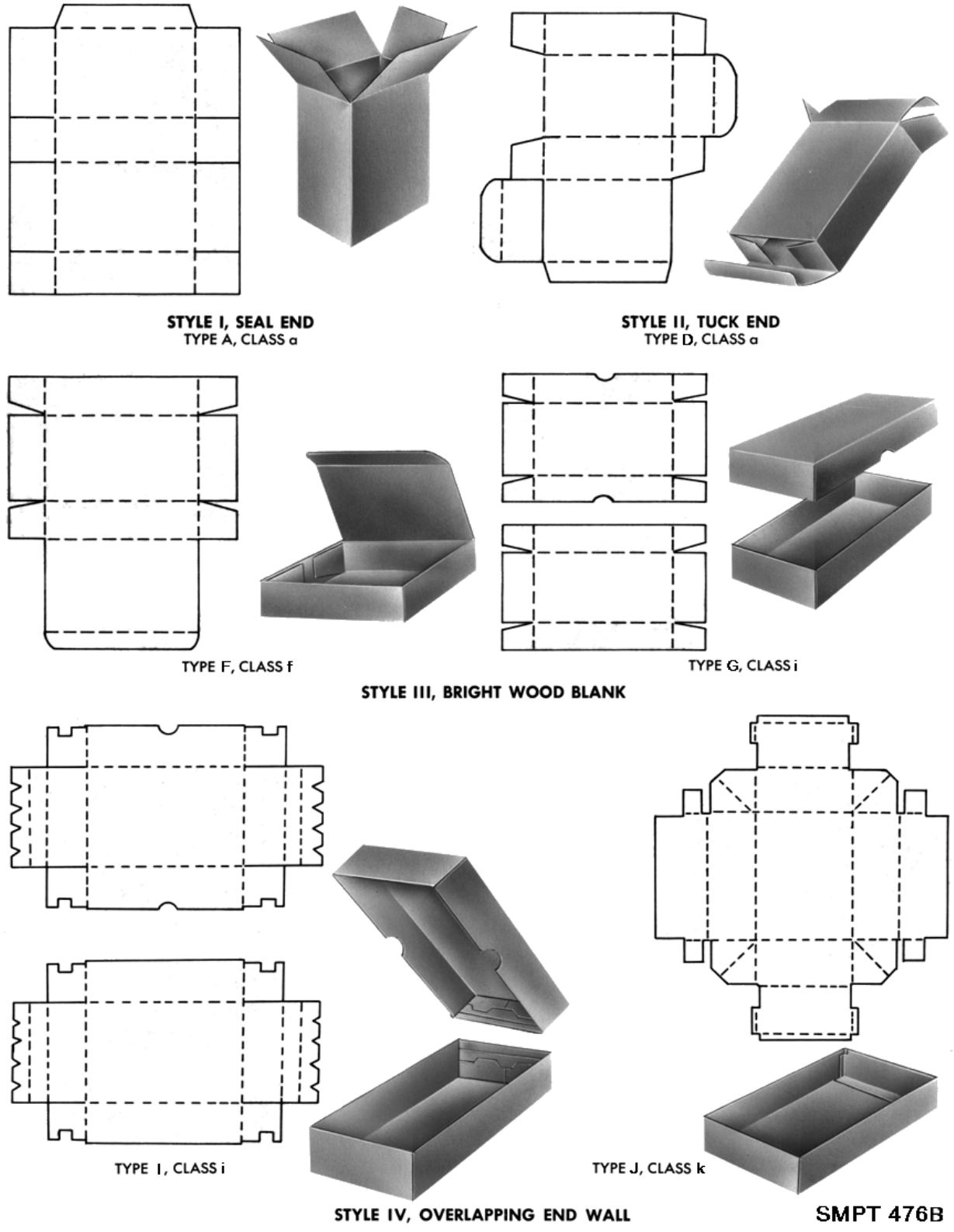

Figure 6-13. Styles I, II, III, and IV of folding paperboard boxes.

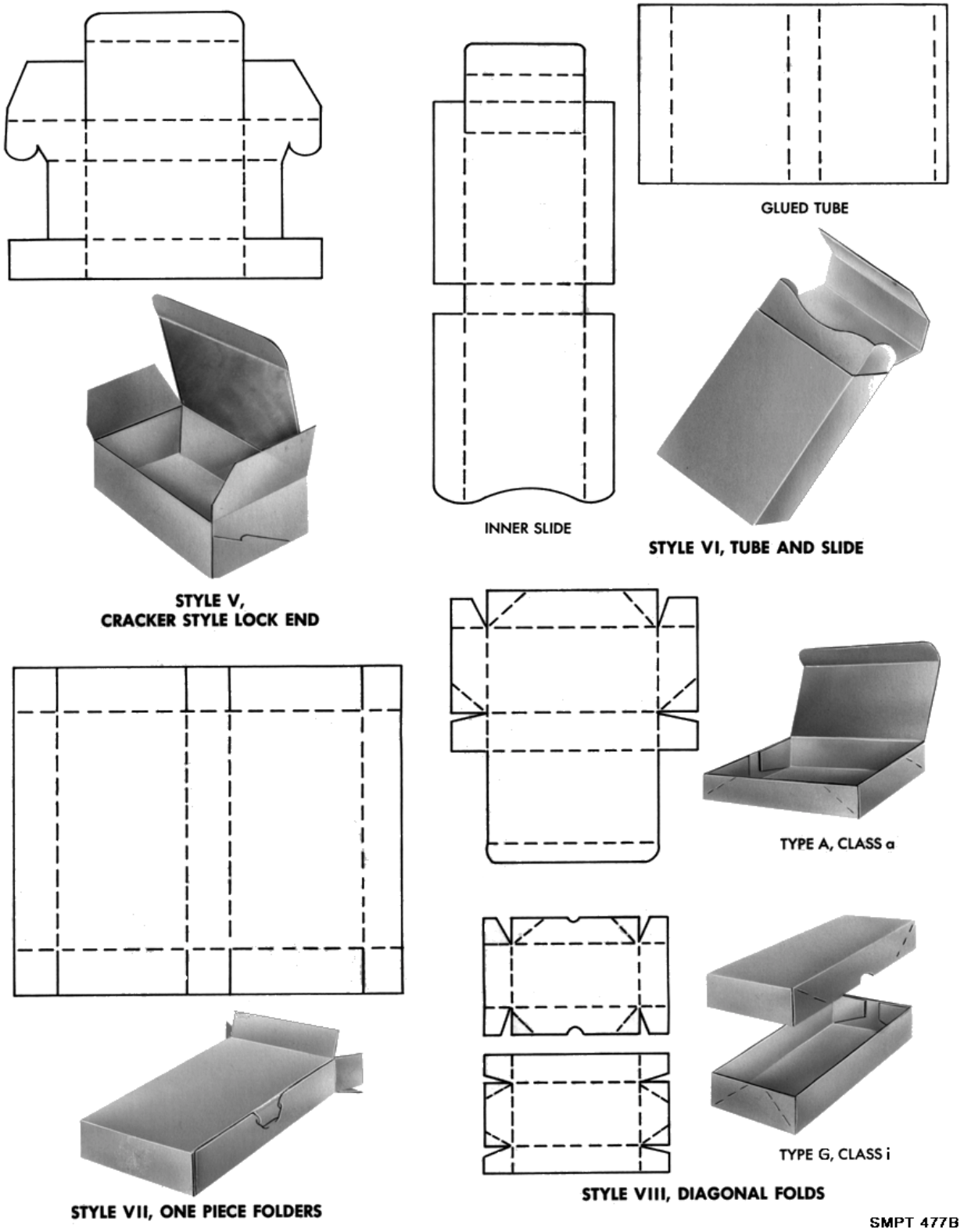

Figure 6-14. Styles V, VI, VII, and VIII of folding paperboard boxes.

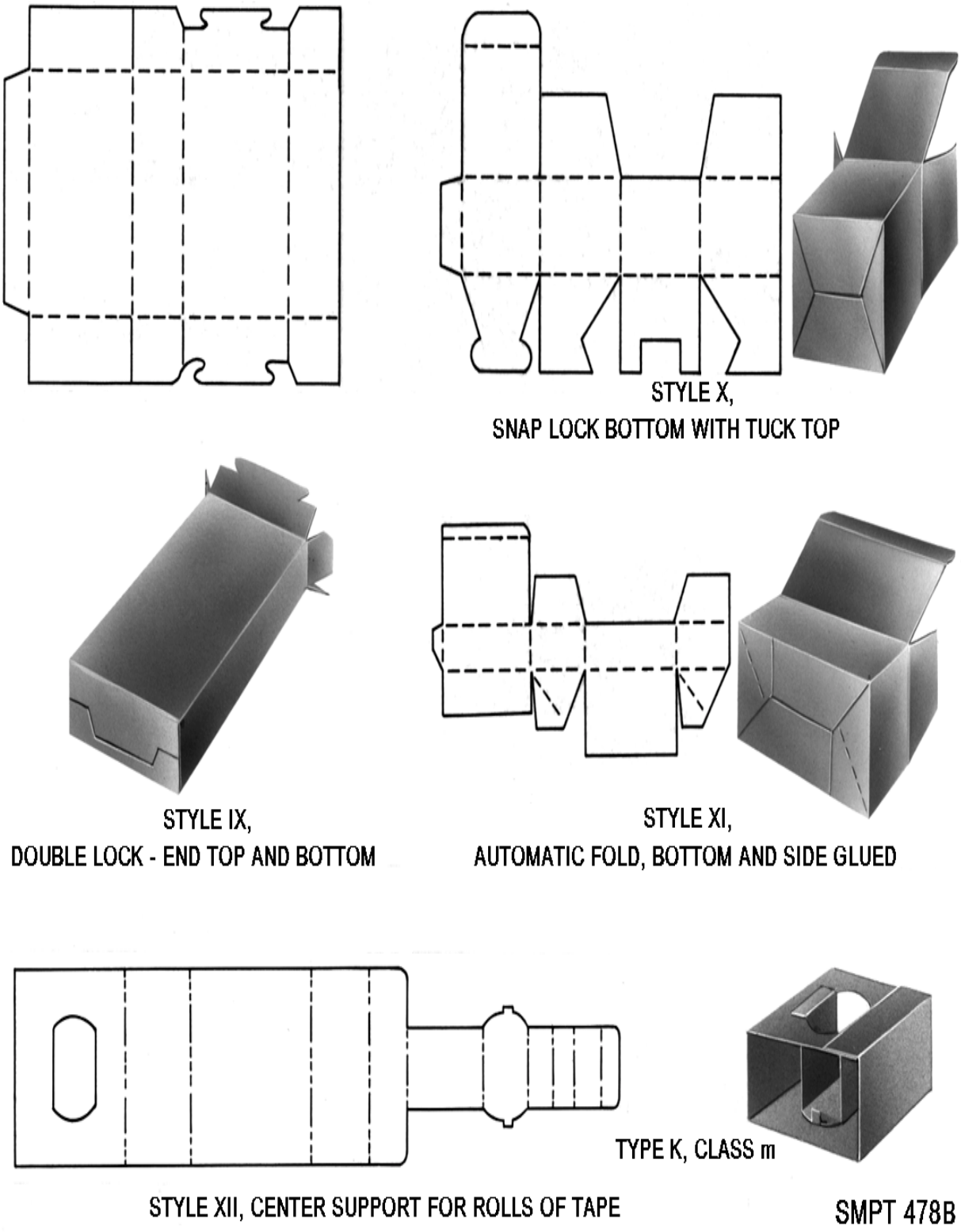

Figure 6-15. Styles IX, X, XI, and XII of folding paperboard boxes.

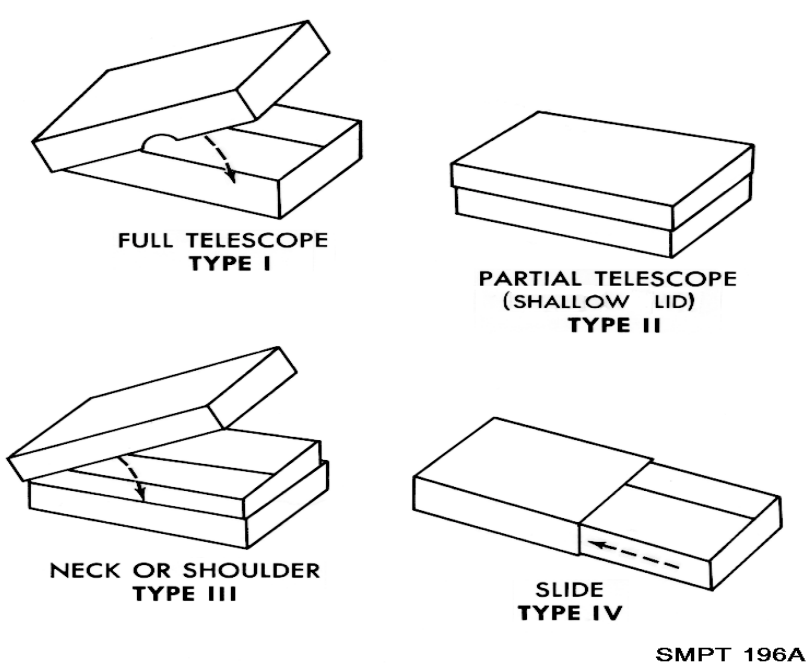

Figure 6-16. Types of paperboard setup boxes.

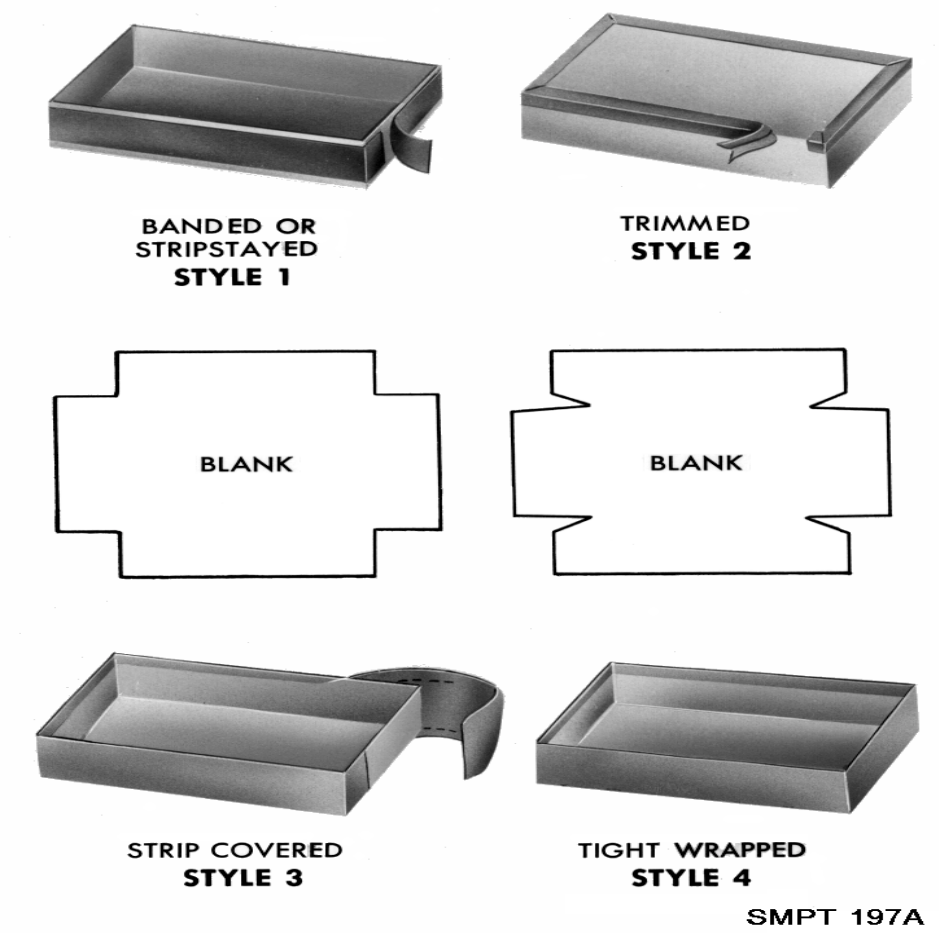

Figure 6-17. Styles of paperboard setup boxes.

INTENDED USES

Setup paperboard boxes are used for interior packing and are used to give added protection to the article and for convenience in handling. Uses by varieties are as follows:

Varieties 1 and 5 Boxes

Boxes that are not water or grease-resistant are intended for use in packaging dry items free from liquids or grease.

Varieties 2 and 6 Boxes

Water-resistant boxes are intended for use in packaging items such as detergents, starch, flour or metal parts that can corrode. Water-resistant boxes are not weather-resistant since the water-resistant characteristic may be a thin continuous film or coating, and the remainder of the box will be absorbent and may require overpacking.

Varieties 3 and 7 Boxes

Grease-resistant boxes are intended for use in packing items that are lightly coated with grease or oil as a corrosion protection. Varieties 3 and 7 boxes are not intended for use in packaging of items from which a large amount of free grease or oil will accumulate.

Varieties 4 and 8 Boxes

Water-resistant and grease-resistant boxes are intended for use in the packaging of items that contain grease as an ingredient, and which will be affected if the item loses its moisture content, such as bakery goods and dog foods. The weatherproof limits are the same as those given above for varieties 2 and 6 boxes.

CLOSURE

Unless otherwise specified, closure of setup boxes shall be secured by means of paper tape of 2-inch minimum width conforming to ASTM D 5486. Unless otherwise specified, telescoping type boxes shall be closed by applying a strip of tape girthwise around the center of the box and overlapping not less than 2 inches or, when specified, by applying a strip of tape that will securely cover the full perimeter seam of the box. Neck or shoulder type boxes shall be closed in the same manner as specified for the telescoping types. Slide type boxes shall be closed by applying a strip of tape centered lengthwise around the box and overlapping not less than 2 inches, or by applying strips of tape over each end of the slide (shell) on each end. Alternatively, setup boxes may be securely closed with strips of 1/2 inch minimum width pressure sensitive, filament reinforced tape conforming to ASTM D 5330. A minimum of two strips of pressure sensitive tape shall be used. Each strip shall extend not less than 2 inches onto each box panel adjacent to the seams of the box.

METAL-EDGED PAPERBOARD BOXES (PPP-B-665)

DESCRIPTION AND USES

Metal-edged paperboard boxes consist of one or more paperboard flats assembled with metal edges. A great number of military depots are equipped with a machine known as "The Metal-Edge Box Stayer". The machine joins and reinforces box corners with a metal edging or stay. The metal-edged paperboard box may be used as a unit or intermediate container to provide protection to the contents or to facilitate handling and storage. Thicker and better grades of material are used in the metal-edged box than are generally used in loading and setup boxes. These factors, together with the metal-edged stiffeners, result in a more rigid box. The

boxes may be stabilized with interior blocks, forms, trays or partitions for additional protection to the contents. The weight limitation for these boxes is 40 pounds.

CLASSIFICATION

Table 6-3 lists two classes and nine styles of metal-edged paperboard boxes used as unit or intermediate containers to provide protection to the contents or for convenience in handling.

Styles A, C, D, and G boxes shall be provided with thumb notches. The neck or collar of style E boxes shall be made from the same board as the base, shall extend to the bottom surfaces of the box and shall be provided with metal stays at the four corners. The base and lid of style E boxes shall be of equal depth and the sum of their depths shall equal the depth of the neck or collar or the inside depth of the box. When specified, style F boxes shall be provided with a pull hole or a pull string. Each box shall consist of one or more paperboard blanks or flat assembled with metal stays to comply to one of the box styles illustrated in figure 6-18. The paperboard shall consist primarily of unbleached kraft fiber and shall be of the thickness specified.

CLOSURE

Metal-edged paperboard boxes are closed by means of gummed tape, as required. Closure of the class 1 boxes may be made with 1- or 2-inch wide tape conforming to A-A-1492 and A-A-1671. Closure of class 2 boxes may be made with 1- or 2-inch wide tape conforming to ASTM D 5486.

Table 6-3. Classification of metal-edged paperboard boxes.

Classes
1 - Domestic.
2 - Weather-resistant.
Styles (see figure 6-18)
A - Full telescope.
B - Partial telescope or shallow lid.
C - One piece, hinged lid.
D - One piece, hinged lid, telescope.
E - Neck or shoulder
F - One piece, hinged lid, drop front.
G - One piece, hinged lid, telescope, book style.
H - Cut-away top case.
J - Bin storage.

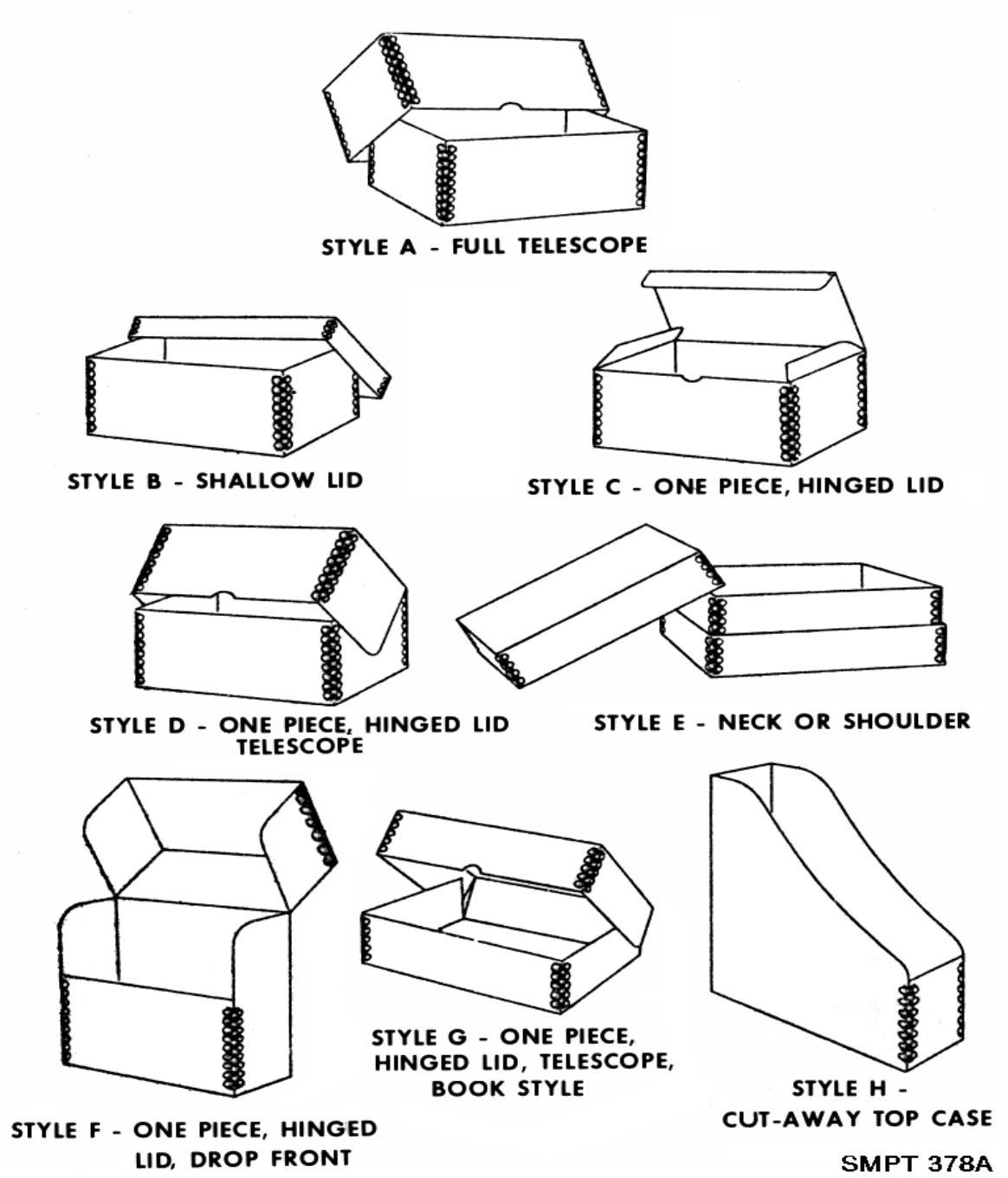

Figure 6-18. Styles of metal- edged paperboard boxes.

TRIPLE-WALL CORRUGATED FIBERBOARD BOXES (ASTM D 5168)

GENERAL

These boxes are made from triple-wall corrugated fiberboard (shown in figure 6-1) which makes them exceptionally good as packing containers. They are used occasionally as unit pack containers, such as for storage batteries.

CHAPTER 7

Cans And Drums

DESCRIPTION, CLASSIFICATION AND SELECTION FACTORS

DESCRIPTION

Cans

Cans are lightweight containers made of metal, paperboard, pulpboard, or a combination of metal and paperboard or pulpboard. Cans may be round, square, oval, oblong, or rectangular in shape. They have a variety of closures and may be used for vacuum or pressurized packaging. Most cans are used for interior packaging.

Drums

Drums are cylindrical, straight-walled containers made of metal, plastic, fiber or plywood, or a combination of metal and fiber, wood or plywood. Drums may be provided with rolling hoops. Rolling hoops may be pressed or expanded from the body of the drum or may be L-bars welded to the body. Drums may have removable or nonremovable heads.

CLASSIFICATION

Cans and drums are broadly classified as to use, that is interior or exterior containers and reusable and nonreusable containers. They are also classified as to composition - metal and nonmetal.

Interior and Exterior Containers

Interior

Interior cans are usually 1 gallon or less in capacity, constructed of lightweight material, and are used for small items. These containers may be utilized for unit packing as specified in MIL-STD-2073-1C. Interior type containers are packed in exterior containers such as fiberboard boxes, cleated panel boxes, wirebound wood boxes, or nailed wood boxes for shipment.

Exterior

These containers consist of cans of larger capacity, pails, reusable type metal containers, and drums. Exterior containers are designed to withstand rougher usage. They may be palletized for convenience in handling.

Reusable and Nonreusable Containers

Reusable

Certain cans, metal containers, and drums are designed for reuse. The reusable type is very convenient for the return shipment of repairable items. This feature is particularly advantageous in cases where repairable instruments or accessories can be packed for shipment to the maintenance overhaul activity in the container in which the replacement item was received. Multiple trip drums may, under certain conditions, be refilled and reused for the shipment of liquid, powdered or granular commodities.

Nonreusable

Single trip containers are usually discarded after their first use. One type, the strippable drum, is filled with a hot liquid which solidifies after cooling. At destination, the drum is torn away from the inclosed product. Other single trip containers, designed of light gauge materials, are discarded after the first trip because of requirements in Department of Transportation's hazardous materials regulation or because the general physical condition of the container would not warrant another trip.

Metal and Nonmetal

Cans and drums are usually made from metal, although cans may be made from fiberboard or paperboard and drums may be made from fiber. The most common metal used in cans is steel, covered with a thin coating of tin or terneplate (lead-tin alloy coating). The most common metal used for drums is mild steel. Some drums, however, are made of aluminum, nickel, or stainless steel. Interior and exterior drums are also made of various plastic compositions.

USE AND SELECTION FACTORS

Use

A wide range of items and commodities are adaptable for shipping in cans and drums. Liquids, semiliquids, semisolids, granular, flakes, and powdered materials, and solids may be shipped in specified types of these containers. Fragile items and precision instruments may be given the high degree of protection they require by the use of cans or drums. Hazardous materials, including corrosives, flammable liquids, and solids must be shipped in containers specifically required or authorized by the Department of Transportation (49 CFR, Parts 170-179) or other regulatory agency.

Selection

When selecting a can or drum, it must be remembered that these containers are structurally rigid in design and are dustproof. They are easy to mark and afford excellent physical protection to contents during shipment and storage. Drums may be less susceptible to pilferage than some other types of containers. Care must be taken when selecting containers. This is particularly true when selecting a container for shipment of dangerous items. For example, a square item packed in a cylindrical container takes about 1.5 times the cube required for the same item when packed in a square container. In addition to the loss of valuable cube, excess dunnage is required to fill the voids when a container of the wrong shape is used.

FIBER DRUMS (PPP-D-723)

DESCRIPTION

These drums are used for an assortment of material loading and shipping jobs throughout the U. S. and overseas. The materials used to construct the fiber drums shall be of the quality normally used by the manufacturer provided that the complete item complies with all provisions of PPP-D-723. For instance, the following facts about the drum shall be true:

- X The gage or thickness of the steel shall be as outlined in Table I of PPP-D-723.
- X Five (5) percent reclaimed fiber shall be used in construction of the drum, unless otherwise specified.

X All materials used in the manufacture of fiber drums intended for contact with food and drugs for consumption must conform to rules and regulations set forth in 21 CFR, Parts 100-129.

CLASSIFICATION

Fiber cans under PPP-D-723 consist of 3 types, 5 grades, and 5 classes in the following manner:

X Type I – Domestic (nonweather resistant)
X Type II – Overseas (nonweather resistant)
X Type III – Overseas (weather resistant)
  B Grade A – for dry and solid material (applicable to all types)
  B Grade B – for semiliquid material (applicable to all types)
  B Grade C – for hot poured materials that solidify on cooling applicable to types I and II only)
  B Grade D – for rolled or cylindrical items (applicable to types I and II only)
  B Grade E – for liquids or articles in liquid, nonregulated (applicable to all types)
    - Class 1 – regular construction (types I and II grade A drums)
    - Class 2 – foil laminated construction (types I and III grade A drums only)
    - Class 3 – integral plastic lining (applicable to types I and III grade A drums only)
    - Class 4 – semi-rigid plastic component (open head loose liner) applicable to grade E drums
    - Class 5 – molded rigid one-piece plastic component (closed head liner) applicable to grade E drums.

USE

These drums have various uses, as explained in the "Description" paragraph. Fiber cans are used in preservation Method 44 and are suitable for use as intermediate containers for small unit packs. They are also appropriate for use as shipping containers. Their content weight and volume capacities range from 60 lbs. for the 30 gallon capacity up to 700 lbs. for the 55 gallon capacity. For example:

X Type I, grade A, class 1 is a non-weather resistant (domestic) drum, used for dry or solid materials (grade A), and has "regular" construction features (class 1). A "class 2" drum is a foil laminated one which is used for highly hygroscopic materials needing a barrier, such as desiccants.
X Type II, grade E, class 4 or 5, are drums used for liquids or articles in liquids that are nonregulated shipments. These types and grades are for normal overseas cargo where handling and storage problems at the destination are not anticipated.

The complete list of specific types, grades, and classes of the drum, their construction, and intended uses may be found in PPP-D-723. Figure 7-1 illustrates a grade D fiber drum. Figure 7-2 illustrates a fiber drum with wood heading. Figure 7-3 shows a fiber drum with chime construction. Figure 7-4 shows the manufacturers marking requirements for the three types of fiber drums.

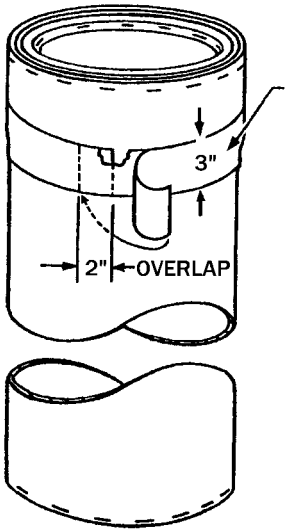

Figure 7-1. Grade D fiber drums.

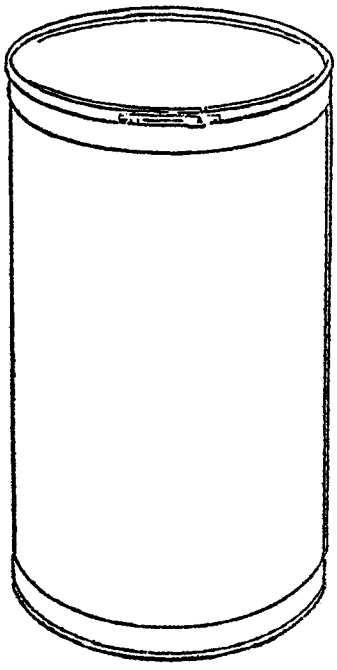

Figure 7-2. Fiber drum with wood heading.

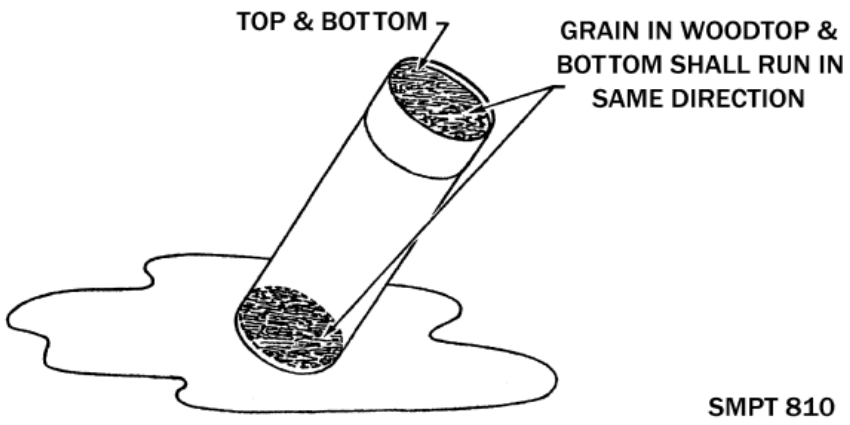

Figure 7-3. Fiber drum with chime construction.

TYPE I

(DOMESTIC TYPE)

(NON-WEATHER RESISTANT)

COMPLIES WITH FED. SPEC PPP-D-723J

FOR DOMESTIC SHIPMENT

GRADE_____ CLASS_____

MAX. WT. OF CONTENTS _____LBS.

MAX. CAPACITY CONTENTS _____GAL.

TYPE II

(OVERSEAS TYPE)

(NON-WEATHER RESISTANT)

COMPLIES WITH FED. SPEC PPP-D-723J

FOR NORMAL OVERSEAS SHIPMENT

GRADE_____ CLASS_____

MAX. WT. OF CONTENTS _____LBS.

MAX. CAPACITY CONTENTS _____GAL.

TYPE III

(WEATHER RESISTANT OVERSEAS TYPE)

COMPLIES WITH FED. SPEC PPP-D-723J

FOR MILITARY OVERSEAS SHIPMENT

GRADE_____ CLASS_____

MAX. WT. OF CONTENTS _____LBS.

MAX. CAPACITY CONTENTS _____GAL.

Figure 7-4. Manufacturers marking requirements.

CANS, COMPOSITE, FOR DRY PRODUCTS (PPP-C-55)

DESCRIPTION

These cans are made of spirally or convolutely wound or lap seam construction. They may be lined with moisture-resistant, grease-resistant, or anticorrosive liners such as parchment, glassine, aluminum foil, polyethylene, etc., as required. The cans may be either round, square, rectangular, oval, or oblong with a variety of covers of either metal or paper .

CLASSIFICATION

Fiberboard and paperboard cans are available in various types, styles, shapes and classes. The sizes of the containers are the sizes which are regularly supplied commercially.

USE

These cans are suitable as containers for a wide range of supply items other than liquids. These include food, dry chemicals, drugs, small hardware, and small repair parts. These cans may be used for Method 10 preservation as established in MIL-STD-2073-1C.

METAL CANS, 28 GAGE AND LIGHTER (PPP-C-96)

DESCRIPTION

These cans are rigid containers made of 28-gage and lighter sheet metal plate. The metal may be either aluminum, tinplate, tinfree steel, blackplate, or any combination of these metals. The cans may be round, square, oblong, pear-shaped, open-top, or double seamed ends. They have a variety of closures, such as snap on caps, screwcaps, spout closures, and friction plugs. Several types may be provided with handles when specified. These cans are air-tight, dustproof, and watervaporproof .

CLASSIFICATION

Cans procured under PPP-C-96 are available in several types and classes.

USE

Depending upon the class and type, cans meeting the requirements of PPP-C-96 are capable of handling a wide range of contents. Types I, II, III, IV, and VII, Class 2, may be used for the methods of preservation 45 and 55 as prescribed by MIL-STD-2073-1C. In addition to items packaged for unit protection, other commodities such as foodstuffs, liquids, powders, pastes, and materials which are dispersed under pressure, may be canned also.

CAUTION

Food products, toilet articles, or medical products may not be placed in cans coated with terneplate. Such cans will be marked "CAUTION --- DO NOT USE OR REUSE AS A FOOD CONTAINER".

CLOSURE

Closure requirements vary with the type and class of can. Screw caps must be secured by automatic mechanical means or by cap wrenches and may not be hand tightened. Snap on closures are secured by full automatic, semiautomatic, or hand band closing or crimping tools. When specified, after filling the can with the product being packed, multiple friction plugs on 1-gallon and larger containers are spot soldered to the friction ring at three points equidistant from each other around the perimeter of the plug. Other methods of preventing the plug from coming loose will be accepted provided they will meet prescribed drop tests.

SHIPPING AND STORAGE, REUSABLE METAL DRUMS (CAPACITY 88 TO 510 CUBIC INCHES) (MIL-D-6055)

DESCRIPTION

These reusable metal shipping drums are constructed with a removable cover secured by a separate exterior locking ring and held in place by a removable nut and bolt. A rubber gasket is supplied to provide a barrier against watervapor. These drums may be fabricated from either aluminum or steel. They may be made from one piece of metal stamped and drawn to size and shape, or they may be formed of rolled metal with a side seam.

CLASSIFICATION

These metal containers are of two types. Type I drums are formed drums and Type II drums are drawn. They are furnished in either aluminum alloy, Class A, or steel, Class S. The drums are available in the sizes shown in table 7-1. Each container size and its corresponding cover and locking ring components are identified by a military standard part number as listed in the table.

Table 7-1. MIL-D-6055 Drums: Metal Reusable, Shipping and Storage

Steel containers							
	Military standard part number				Nominal capacity (cu. in.)	Inside diameter	Inside depth
Container assembly	Container body	Cover	Locking ring	Gasket			
MS-24347-1	MS24347-21	MS-24347-41	MS-24347-61	MS-24347-81	88	5	4.5
MS-24347-2	MS-24347-22	MS-24347-41	MS-24347-61	MS-24347-81	167	5	8.5
MS-24347-3	MS-24347-23	MS-24347-42	MS-24347-62	MS-24347-82	149	6.5	4.5
MS-24347-4	MS-24347-24	MS-24347-42	MS-24347-62	MS-24347-82	224	6.5	6.75
MS-24347-5	MS-24347-25	MS-24347-42	MS-24347-62	MS-24347-82	282	6.5	8.5
MS-24347-6	MS-24347-26	MS-24347-43	MS-24347-63	MS-24347-83	340	835	6.0
MS-24347-7	MS-24347-27	MS-24347-43	MS-24347-63	MS-24347-83	425	8.5	7.5
MS-24347-8	MS-24347-28	MS-24347-43	MS-24347-63	MS-24347-83	510	8.5	9.0

Note. Add D in place of dash in the part number of aluminum alloy.

USE

The use of these containers is limited to lightweight items. This type of container is used principally for the preservation and packing of such items as delicate instruments, expensive relays, and small electric motors which require inspection or lubrication during storage. These containers may also be used for preservation by Method 40 and Method 50, where the size or weight of the item is too great for the nonreusable sealed can.

NOTE

The US Postal Service has advised that reusable metal mailing containers with split-ring type closing devices are damaging mail bags and other mail when placed in parcel post channels. The projection of the split-ring and exposed end of the protruding screws cut the canvas or nylon fabric of the bags during handling and while in transit. When containers are handled as "outside" pieces, they damage other mail. Split-ring closure type reusable metal containers are nonmailable under the provisions of Section 123.2 of the U.S. Postal Service Manual, unless the projections of the split-ring and exposed end of the protruding screws are properly cushioned and wrapped to prevent injury to postal employees and damage to mail and equipment.

CLOSURE

Reusable metal containers are provided with gasketed, removable covers. The cover, or lid, is held in place by a circumferential locking ring that is secured by means of a nut and bolt. After installing the gasket in the cover groove with the flat surface of the gasket outermost, place the cover on the container. Assemble the locking ring to the cover and container. Insert the bolt and tension the nut to a minimum torque pressure of 4 foot-pounds plus or minus 1/2 foot pound. During the tightening of the nut and bolt, tap the locking ring repeatedly with a rubber, fiber, or plastic mallet to relieve the friction, thereby assuring a uniform and effective seal. In lieu of the specified torque-indicating device, closure of the container may be accomplished using a common screwdriver having an overall length of 12 inches. If this procedure is followed, a spot check of torque with a torque-indicating device should be made to assure tensioning of the nut and bolt.

SEALING

In order that opening or tampering can be readily detectable, seal each container of serviceable material with a wire and metal seal affixed to prevent opening of the container without destroying the seal. After the closure is completed, insert the sealing wire through the drilled head of the locking ring bolt and the rim of the metal container, draw the wire tight, twist the ends together and apply a metal seal so that the bolt cannot be loosened without breaking the wire or destroying the seal. Alternatively, the sealing wire should be placed underneath the bolt in the lower hold of the lugs of the locking ring and similarly tightened and sealed. The sealing wire should be tucked under to prevent injury to handling personnel.

CONSERVATION, REUSE, AND REPAIR

Reusability

As the reusability feature has been a factor in the general adoption of metal containers for preservation and packing military materiel, it is of major importance that attention be given to their conservation, repair, and reuse.

Special care should be taken to minimize loss of any integral parts of the empty containers. It is recommended that caution be exercised in the repair of reusable containers, since the overall cost of repair and materials should not exceed 65 percent of the purchase price of the container. In the event a minor repair is deemed economical, the information in the following paragraphs may be used as a guide. Immediately upon removal of material from metal containers, old markings and tags should be obliterated. The cover, gasket, exterior locking ring, bolt, and nut should be fastened together to prevent loss.

Damage to Body

The reusable metal containers have bodies which are either soldered or deep drawn from a single piece of metal. Soldered bodies are more susceptible to damage from dents and abrasions incurred in rough handling. Dents in the body of the container affecting the soldered seam, joint, or lip will make the container unfit for further use (figure 7-5). Dents, other than the above, in the body of the container are considered repairable and can be removed by hammering, pressing, or other suitable means. The painted surfaces are to be retouched or repainted, where necessary, and the container returned to stock or reused.

Damaged to Cover

Small dents in the cover or lid of a metal container are considered repairable provided they do not distort the cover or impair assembly of the cover to the gasket or container (figure 7-5). Such dents are removed and bare spots retouched, where necessary, in accordance with the preceding paragraphs. If the dent in the cover occurs in the rolled flange that holds the gasket in place, or is otherwise distorted, the cover should be condemned and replaced by a serviceable one from a drum from which a body has been scrapped (figure 7-5). If parts are not available from this source, spares should be requisitioned from stock. In the event that removal of an otherwise repairable dent in the cover results in distortion, the cover should be condemned.

Damage to Gasket

Proper closure of MIL-D-6055 metal drums to obtain a watervaporproof seal is dependent upon the condition of the gasket. Consequently, the importance of ascertaining serviceability of the gasket by visual inspection cannot be overemphasized. If the gasket is torn, distorted, weather checked, or deformed due to stretching, it must be replaced by a serviceable one (figure 7-6). Reusability of the gasket, as well as effectiveness of the watervaporproof seal, depends upon proper assembly of the gasket to the cover and to the container. After assembly to the cover, the flat surface of the gasket must be in position to bear against the rolled lip of the container.

Damage to Locking Ring

To insure proper sealing of the gasket to both the cover and the container, the locking ring must exert a uniform clamping pressure. Small dents in the locking ring will impair this function of the ring (figure 7-6). Any attempt to remove such dents is considered impracticable due to the possibility of creating further damage. Consequently, it is necessary to replace locking rings when they are damaged as previously described.

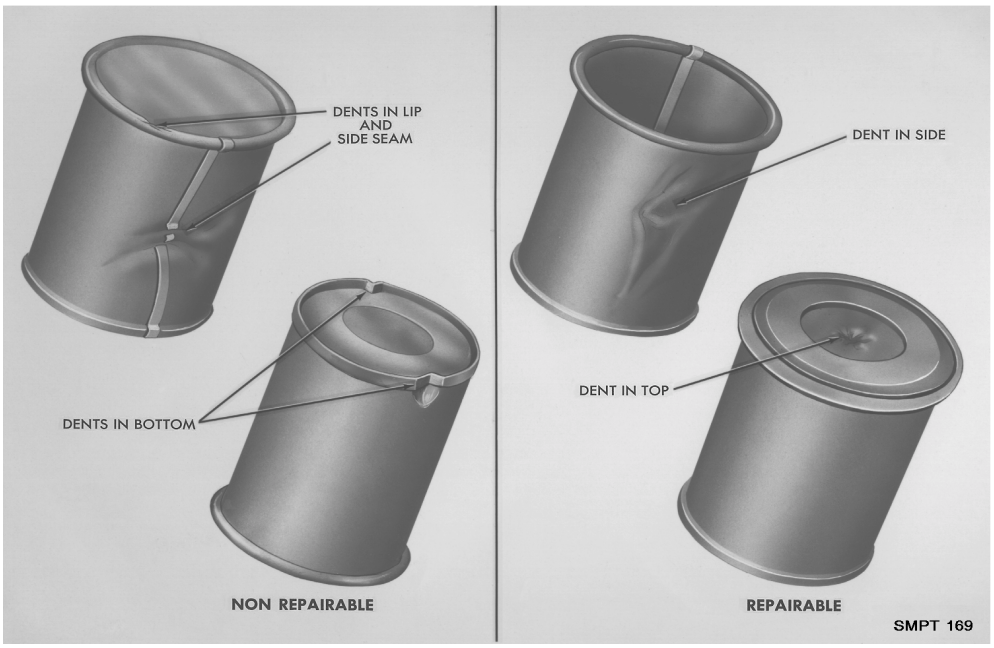

Figure 7-5. Nonrepairable and repairable dents in drums.

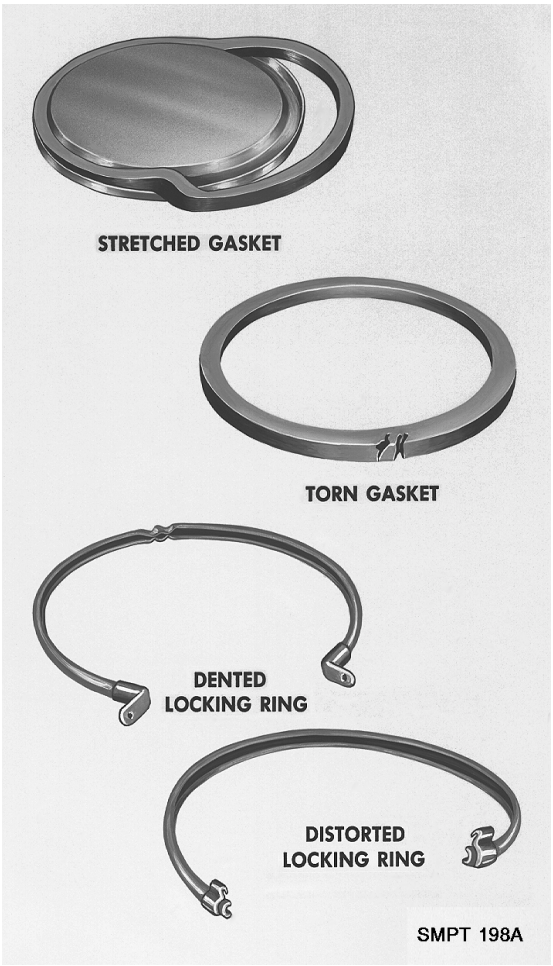

Figure 7-6. Nonrepairable gaskets and locking rings.